MODERN Machine Shop

HOWARD CAMPBELL, Editor

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MODERN Machine Shop

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Grain Size in Steel

In this article Dr. Enos tells how the grain size in steel accounts to a large extent for the "personality" of steel. He also shows how the grains are measured, and discusses the effect of grain size on hardenability.

BY GEORGE M. ENOS

Assistant Professor of Metallurgy, University of Cincinnati

THE large attendance at a recent regional meeting of the American Society for Metals, at Columbus, Ohio, is evidence of the wide spread interest in the subject of grain size in steel.

In the past, the selection of steel for various purposes has been based upon the personal preferences of the user as well as on the chemical analysis and mechanical properties required. The personal preferences were based, presumably, on observations as to the behaviour of the steel in process of fabrication, in heat treatment and in service.

The observations made were rarely quantitative in nature, nevertheless it has long been understood that steels of the same analysis, although produced by different makers, differed in characteristics that could not be included in the usual specifications. This condition has sometimes been summarized by the statement that each steel has its individual personality. The character of any steel is often revealed in the heat treatment, and where difficulties have been encountered, it has often been possible to eliminate some of the difficulties by changing the source of supply without, however, making any change in the analysis specifications.

Changing to a different brand of steel did not necessarily imply that the rejected steel was defective; it simply meant that the "personality" of the rejected steel did not suit the needs of the user. These differences in behaviour, while most prominent in tool steels, have also been observed in steels used for other purposes, such as forging steels and sheet steels.

Various terms have been used to denote the inherent characteristics of steels. The term "personality" has already been mentioned. "Body", "timbre", and "hardenability" have also been used. The meaning of the

term "hardenability" is fairly definite, but "body" and "timbre" are somewhat vague, although they are intended to convey the same meaning as "personality" and in tool steels have some relation to hardenability. Attempts to correlate these terms with some easily-measured property such as tensile strength or hardness have not met with much success.

The size of the grains of which any steel is composed have been found to have a distinct relationship to "hardenability" and, to a certain extent, at least, to the intangible value designated as "body" and "timbre." It is understood, therefore, that "body", "timbre", and "personality" refer to those intangible qualities in steel which cannot be evaluated in terms of chemical analysis, or by the usual mechanical tests. These qualities have been varied, probably unconsciously until recent years, by the steel manufacturers; consequently steels of identical analysis but produced by different plants have varied in important inherent characteristics. Recent attempts to evaluate these properties in terms of grain size have been somewhat successful.

No attempt will be made here to list all of the investigators, or to give many references to the technical literature on the subject of grain size in steel. Information contained in articles and lectures by Bain, McQuaid, Grossman, Herty, Shepherd and others has been used in preparing this article.

Measurement of Grain Size

In any discussion of grain size in steel, a certain amount of confusion always exists as to just what constitutes "large grain size" or "small grain size." All metals and alloys are crystalline in nature, but the crystals are usually imperfect and are called "grains", rather than "crystals." Very large grains in a piece of metal may be seen with the unaided eye, as, for example, the grain structure of brass, which is often visible in door handles. On the other hand, grains may be so small that they can only be observed with the aid of a powerful microscope.

Grain size can be measured in several different ways. On a fractured piece of metal the naked eye may be sufficient to tell whether the grains are fine or coarse; i. e., large or small. More exact measurements can be made on representative flat sections of metal that have been polished and etched. The structure may be noted qualitatively with the aid of a microscope, or the structure may be photographed. On photographs made at a definite magnification, a planimeter may be used to measure the cross section area of the grains. If a sufficient number are measured, an average value for the grain size can be obtained.

Another method, developed by Jeffries, consists of projecting the microstructure onto a screen or photographing it at a known magnification. A circle is drawn enclosing a representative area, then the grains totally enclosed are counted and to the number obtained is added one-half the number of grains cut by the circle. The area of the circle and the magnification both being known, it is an easy matter to calculate the average number of grains per unit area, or the average area of the individual grains.

One of the common methods of quickly estimating grain size is by the use of charts. A suitable chart would consist of a series of circles enclosing a number of hexagons, accompanied by photographs of representative microstructures. The number of hexagons in each circle would

correspond to the number of grains in the accompanying photomicrograph. The usual chart is made up in accordance with A. S. T. M. specifications, which are somewhat as follows:

The examination is made at a magnification of 100 diameters. The index number N refers to a logarithmic series.

Number of grains per square inch at 100 diameters.

N	Mean	Max.	Min.
1	1	1.5	....
2	2	3	1.5
3	4	6	3
4	8	12	6
5	16	24	12
6	32	48	24
7	64	96	48
8	128	....	96

Figure 1 serves as an illustration of the general method of using a chart.

In determining grain size in steel for purposes of comparison, it is advisable to place the samples to be compared in the same heat treated condition. This may be accomplished by what is commonly called the McQuaid-Ehn test.

The McQuaid-Ehn Test

Using a standard carburizing compound, the test samples are carburized, usually by the pack method, at 1700 deg. F. for eight hours. This treatment will develop a hypereutectoid case. The carburized steel is cooled slowly from 1700 deg. to 1150 deg. F., usually at a rate of only a few degrees a minute. After reaching 1150 deg. F., the cooling rate may be greatly increased if desired.

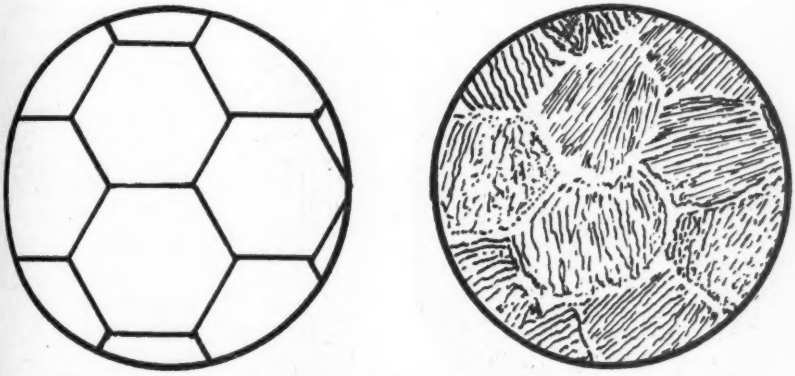


Fig. 1—Drawing showing use of a chart for measurement of grain size in steel. The area of each hexagon equals ½ square inch, equivalent to two grains per square inch at 100 diameters magnification. The shaded areas in the structural drawing represent pearlite, surrounded by a white network of cementite. It is evident that the grain size of the steel is as indicated is about No. 2. In practice, the charts are larger, and are compared with the actual steel structure as projected or photographed. Charts for grain sizes 1-8 are used in practice.

The essential features of the test are that the carbon content of the outer zone or case shall be increased to over 0.9 per cent C, and that an annealed structure, pearlite and cementite, shall be obtained. Naturally, the time, temperature, or source of carbon may be varied, as long as all samples to be compared are treated alike and the desired structures are obtained.

After cooling, the remainder of the test consists in examining the samples

at a magnification of 100 diameters or at other magnifications, if required. Grain size can be compared by methods already given and other features noted. The types of structure observed in the case will vary between the following extremes:

Normal Structure. The cementite will appear as relatively smooth, thin boundaries (envelopes) around fine lamellar pearlite. The grains are usually large, but there may be considerable variation in the actual size. A normal structure is shown in Fig. 2.

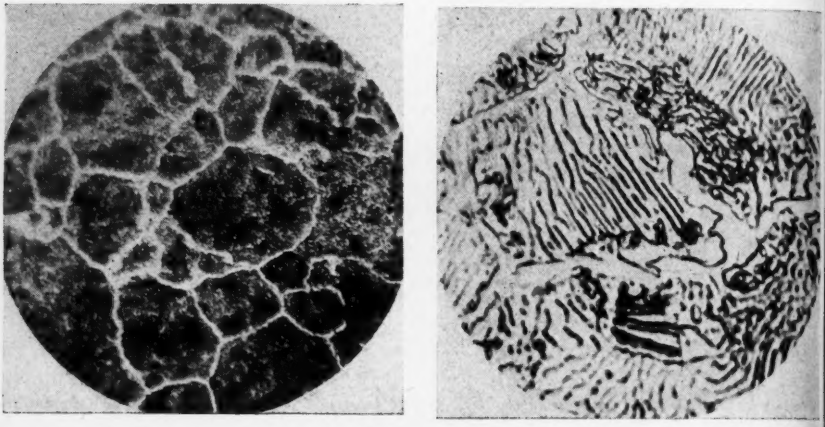


Fig. 2—(Left) Photomicrograph of a normal steel, after McQuaid-Ehn test, at a magnification of 100 diameters. Grain size, 2. (Right) Photomicrograph of a normal steel at high magnification (750 diam.). Note the laminated pearlite and cementite boundaries.

Abnormal Structure. The cementite will appear as thick boundaries or envelopes around the grains, with free ferrite adjacent to the cementite. Usually the cementite of the pearlite is somewhat spheroidized. Sometimes the cementite network is broken up and little, if any, lamellar pearlite is present. Abnormal structure is shown in Fig. 3.

The McQuaid-Ehn test has probably been most widely used in connection with case hardening practice, but it can, of course, be used with any steel, since if the carbon is very high, as, for example, over 0.9 in the original steel, the McQuaid-Ehn heat treatment will prevent decarburization and possibly will even produce slightly greater carbon content in the case.

The terms "normal" and "abnormal" as used above refer more particularly to case hardening practice. It has been found that after the hardening quench, abnormal steels are likely to have soft spots.

It will be noted that the McQuaid-Ehn test facilitates the measurement of grain size by any of the methods previously mentioned. Steels of different composition, or of the same composition but from different sources, can be given identical heat treatments, and these heat treatments should develop grain size characteristics that can readily be compared. Of course, carefully-conducted annealing or normalizing operations will also develop grains that are easily measured in certain steels. However, experience has shown that the measurement is easy after the Mc-

Quaid-Ehn test has been applied, and in some steels may be difficult unless this treatment is given.

Comparison of grain size in different steels carburized as described above are justified only if the following assumptions are valid:

1. That the grain size to be developed by the test is inherent; i. e., fixed in the ingot.

2. That no intervening treatment such as hot or cold work or previous heat treatment will affect the grain size as developed by the carburizing treatment. The first assumption is probably valid. Since it is well known that prior working or heat treatment will affect the grain size, care should be taken to avoid dissimilar treatments of samples before carburizing, if grain size of different samples is to be compared.

One other factor remains to be considered in connection with this test. Some steels coarsen at temperatures below 1700 deg. F. Usually the temperature at which grain size coarsens on heating is above 1700 deg. F.; nevertheless this factor may not be neglected and preliminary tests may be necessary to find the coarsening temperature for any given steel. Thus grain size can be varied at will for many steels by varying the heat treatment, as shown by Bain in a recent paper.

The Importance of Grain Size in Steel

In general, the interest in grain size in steel is justified. It has long been understood that, as a rule, a coarse-grained steel is weaker than a fine-grained steel. The characteristics of a steel in working, in hardening, and in service are thus a function of grain size. The following ideas concerning grain size and its importance are largely abstracted from the discussions at the Columbus meeting.

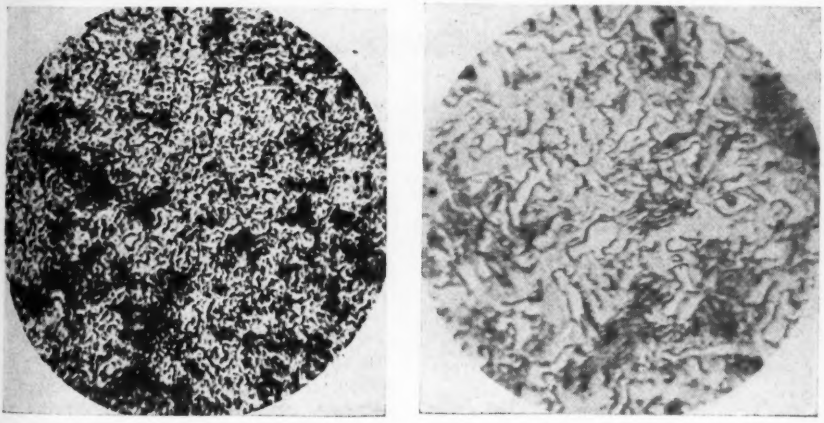


Fig. 3—Photomicrograph of an abnormal steel (McQuaid-Ehn test) at (left) 100 diameters, and (right) at 800 diameters. Grain size, measured at 100 diameters. No. 7—No. 8.

Fine-grained steels may permit direct quenching, although the fracture may appear poor.

For best machineability, a large grain size is preferred. If the grain size of the steel as received is not correct, grain growth can be inducted by proper normalizing. The correct

normalizing, or grain growth, temperature varies, of course, with the "body" of the steel so that it may have to be determined experimentally.

The toughness of a steel as represented by impact values also varies with grain size, as indicated by the following data presented by H. W. McQuaid.

	%C	%Mn	Grain Size	No.
Steel A	0.4	.85	Fine grained	7 — 8
Steel B	0.4	.80	Coarse "	1 — 2

These steels were quenched in water from 1500 deg. F. and were then drawn as indicated below. For the same sections 25 per cent of the B samples developed cracks, whereas the A samples came through the quench in excellent condition. The samples were tested by the Izod method for impact values.

Drawing temperatures deg. F.	Steel A		Steel B	
	Izod impact No. in foot-pounds	Brinell hardness No.	Izod impact No. in foot-pounds	Brinell hardness No.
600	48	242	9½	267
800	66	234	10	234
1000	77½	207	14½	212
1200	98	190	32½	184

As the tempering temperature increased, the hardness numbers decreased and the impact values (toughness) increased for both steels.

The Brinell numbers are comparable. There is a very striking difference in the impact values of the two steels, which had essentially the same analysis and had been treated in the same way, but which had different grain size characteristics.

Small grain size is preferred for hardening, since greater toughness is secured and there is less danger of cracking.

Depth of Hardness

When it is desired to know how deeply a steel will harden on quenching, it is a simple matter to take a sufficiently large section such as, for example, a 1-inch diameter round, and quench a representative piece from the proper hardening temperature. The piece may be fractured and an

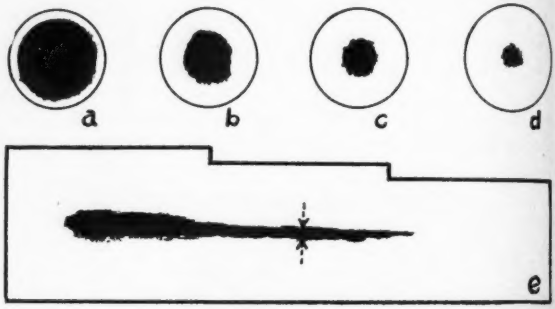


Fig. 4—Showing depths of hardening. The samples a, b, c and d, show variations in hardening depth from very shallow to a very deep hardening steels, in diagram form. Samples when polished and etched will vary in the colors between the hardened and unhardened regions. The sample (e) is a diagram showing how the depth of hardness is measured by Shepherd's method.

estimate made of the depth, or, preferably, the sample may be sectioned with a cut-off wheel, polished and etched, and the depth of hardening measured by means of a microscope fitted with a micrometer eye-piece.

On a flat cross-section, the depth of hardening may also be found by exploration of the section with a suitable hardness tester such as the Rockwell machine. Naturally, in making comparisons between different samples, great care must be exercised to insure that the heating and quenching conditions are comparable. The

section must be large enough so that it does not harden through. Different depths of hardening are indicated in the diagram, Fig. 4.

Shepherd has suggested several improvements on this method. (Trans. A.S.S.T. Jan., 1930.) In his experimental work he used slabs of varying thicknesses, cut from bar stock the diameter of which was under 3⅜ in. When larger diameters were used, several steps were accurately ground on each slab so that the center step was 1¼ in. wide. Numerous steels were investigated as to their hardening characteristics, care being taken to quench all samples alike. His results were reported as "hardenability" numbers, the numbers referring to the number of thirty-seconds of an inch in the thinnest section which did not harden through.

The drawing Fig. 4e shows the method by which the measurements were made. Thus a "hardenability" number of 10 would indicate that on the thinnest section which would not harden through, the unhardened zone was 10/32-inch thick. Shepherd has also emphasized the importance of fracture characteristics and expressed these in numbers coupled with the "hardenability" or penetration numbers.

For many purposes requiring hardened steels, shallow hardening steels are preferred. An example of this is found in gears, which are subject to distortion in hardening. Less distortion is produced with plain carbon steels, which do not harden to great depths.

Relationship of Grain Size and Hardenability

Variations in grain size affect hardenability somewhat in the following manner: If, upon heating, large grain size is produced, the hardened product, martensite, which is obtained by quenching and retained by moderate tempering, is of poorer quality than that obtained upon quenching a steel of finer grain size. This is particularly noticeable in the ductility values. Bain has offered an explanation of this phenomenon, based upon the idea that higher internal stresses exist in the hardened product when the grain size is large.

Bain has published charts (Trans. A.S.S.T. Nov., 1932) showing how hardenability can be changed by appropriate preheating, even though the final quenching temperature is the same. He used, for example, a .74 per cent carbon steel in samples 1 in. in diameter. It was found that the shallowest case was obtained on a steel with a grain size of 5, while the deepest case was obtained with a grain size of 2. Intermediate depths were obtained with intermediate grain sizes. Presumably, finer grain sizes would produce very shallow cases as compared with grain size 5. All samples were quenched from the same temperature, but the preliminary heating was 1375 F. deg. for grain size 5 and 1800 deg. F. for grain size 2.

Changing the carbon content will also change the depth of hardness, up to about 1 per cent C. Since, as has just been indicated, grain size can be varied by heat treatment prior to the hardening quench, it is pertinent to inquire also into the effects of alloying elements on grain size and hardenability.

Effect of Alloying Elements On Hardenability

Grain growth due to preliminary heating, or to heating for quenching, can be restricted by the addition of certain alloying elements which form stable carbides. Some of these ele-

ments are vanadium, molybdenum, tungsten and chromium. With one or more alloying elements of this type present, it is possible to vary the depth of hardening. By heating only to the lowest permissable temperature for hardening, a small grain size and shallow hardening on quenching will be obtained.

On heating to higher temperatures some of the carbides will be dissolved and a greater depth of hardness can be obtained. The grain size will not increase markedly in this latter case, for some of the carbides will remain undissolved and very finely dispersed. These very small carbide particles have the power to restrain grain growth.

Certain elements, notably silicon, manganese, and chromium, confer upon steel the ability to harden to a greater depth than plain carbon steels of the same carbon content. Now if alloying elements be paired up properly, great depth of hardness can be obtained without increasing the grain size.

Control of Grain Size and Hardenability in Plain Carbon Steels.

Earlier in this discussion it was pointed out that grain size was to some extent, at least, an inheritance from the ingot stage of steel manufacture. One of the reasons for difference in "body" or "personality" of steels of similar analyses is the difference in deoxidation practice in finishing and pouring the heats of steel. The amount and nature of the deoxidizing reagents added varies in different steel-making processes, but an elaborate discussion of the advances that have been made recently in this important field cannot be undertaken here.

Consider the effect of aluminum when added at the end of the heat. Aluminum plus iron oxides produces aluminum oxide plus iron. The aluminum oxide may unite with other oxides present, or may possibly remain unaffected. In any event small non-metallic inclusions are formed. When these are adequately dispersed, it is believed that they act to prevent grain growth. If segregated, the inclusions are known as "dirt", or slag, and may be quite harmful to the dynamic properties of the steel. Certainly in plain carbon steels, and probably in alloy steels, the dispersion and size of the non-metallic inclusions exercise an important effect on the inherent grain size characteristics of the steel, fine particles, evenly dispersed, acting in the same general way as carbide-forming alloying elements.

Steel mills that are able to furnish steels with definite inherent grain size characteristics do so by careful control of the deoxidation period in the making of the steel, or by the use of alloying elements, or by using a combination of the two methods.

General Discussion

Steel is composed of crystals or grains. The architecture of the steel is governed by the nature and size of these grains. The preceding discussion has dealt principally with the size of these grains. The actual constitution of the individual grains depends upon the thermal and mechanical history of the steel. In general we may think of all steels as consisting, when cold, of a solid solution of carbon and other elements in iron, which is known as austenite. That is, each and every grain is, at a temperature just below its "freezing" point, like its neighbors in that it contains carbon and small amounts of manganese, silicon, and other elements actually dissolved in the iron. The non-metallic inclusions are not

dissolved to an appreciable extent, and in some alloy steels carbides are also present, separate and distinct from the austenite.

This condition continues to exist as the steel cools until a range of temperature known as the "critical range" is reached. Below the critical range the following structures may exist: (1) iron and manganese carbides, and (2) ferrite (iron containing small amounts of impurities) if the cooling has been very slow. If the cooling has been rapid, metastable transition products of austenite are formed, the chief of which is martensite—a very hard constituent. In reheating above the critical range, austenite is again formed.

The important factor is the grain size of the austenite. In castings, the grain size is very large. In hot-worked steels the grain growth is controlled or broken up by the hot working operations—rolling, pressing, forging, and so on. Any given sequence of operations will produce definite grain size, the controlling factors of which are, first, the inherited characteristics of the steel, and second, the mechanical and heat treating processes employed.

Regardless of the grain size, structural constituents such as ferrite, cementite, ferrite and cementite eutechtoid (pearlite), martensite, austenite, or other constituents will be formed, the type of formation depending upon the rate of cooling from above the critical range. The grain size in a piece of cold steel is an inheritance from the austenite grain size. The austenite grain size is influenced by (1) the method of deoxidation; i.e., the size and dispersion of non-metallic inclusions, (2) the alloying elements present, if any, and (3) the thermal and mechanical treatment of the steel.

Summary

Steels from different sources may have the same chemical analyses and much the same mechanical properties, and still differ in their response to heat treatment or in their behaviour in service. Thus each steel has a "personality" and steel mills have, in the past, capitalized the personalities of their steels by emphasizing trade names, rather than chemical analyses. It is now admitted by specifiers that "personalities" in steel do vary, and cannot be defined exclusively in terms of chemical analysis.

The attempts to define types of personality in steels have led to extensive studies of grain size and hardenability characteristics. It is now possible to purchase steel to meet grain size specifications, and thus secure the kind of hardenability desired.

No attempt has been made to discuss the effect of varying grain size in steels of low carbon content, although it has been shown, for example, that grain size has a definite relationship to deep drawing characteristics in sheet steel.

"Globe Special Machinery"

The Globe Tool & Engineering Co., 402 Davis Ave., Dayton, Ohio, has issued a catalog of the special machines made by this firm. The book contains complete descriptions and illustrations of the different size of Globe dynamic balancing machines, Globe Self-Leveling Static Balancers, Globe Automatic Coil and Peg Machines, Globe Wire Skinners, Globe Universal Coil Winders, and Globe Four-Pole Armature Winding Machines.

The book is of the loose-leaf type, consisting of an attractive cover enclosing a set of loose leaves—one for each type of machine described. A copy of the catalog is available without charge to any metal-working plant executive or executive of a plant building electrical machinery.

The Arc Welding of Copper

By Wilmer E. Stine

Experimental Engineer, The Lincoln Electric Company, Cleveland, Ohio

COPPER, believed to be the oldest metal known to mankind, is being employed in a constantly widening field of industrial applications, among which is the tremendous additional demand for copper for tanks and vats due to the repeal of prohibition. And as with other metals, the fabrication of copper units has been greatly simplified through the use of the welding process. Today no metal is of great industrial value unless it can be welded efficiently and economically.

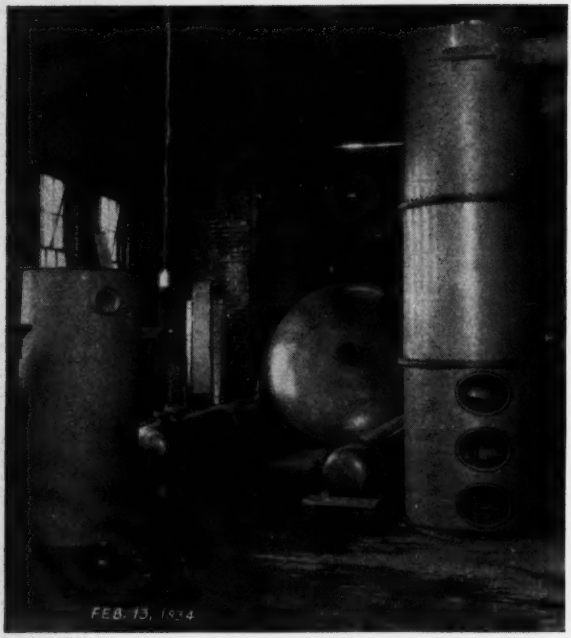


Fig. 1—By using arc welding in the construction of this copper distillery equipment, many hours were saved.

The welding of copper is not new, however. For many years the rotor bars and rings of Lincoln motors have been arc welded, and copper tanks and containers were being built by job welders five or six years ago.

Research is continually going forward in the welding industry, however, and has thus far served to improve the methods employed so that today any welder proficient in the joining of other metals can arc weld copper with the same unvarying success.

There are two successful methods of welding copper with the carbon arc, one in which pure copper filler is used, and the other using phosphor bronze. When phosphor bronze is used, the operator must be careful to use the correct grade. Ductile welds can be made in copper with the carbon arc, using phosphor bronze, at the rate of 8 inches to 12 inches per minute on ½-inch plate and up to 40 inches per minute for thin sheets.

When a pure copper filler metal is used, the filler metal and the base

(Illustrations courtesy Lincoln Electric Company)

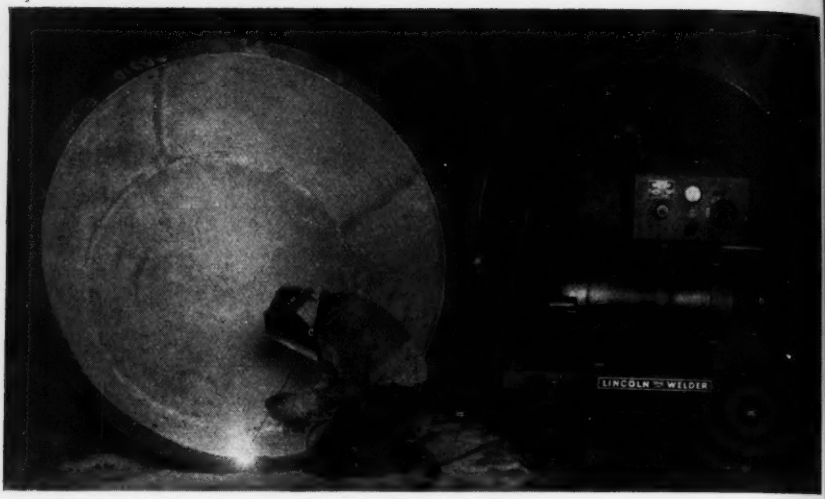


Fig. 2—Using a carbon arc to weld a copper cooking kettle for a paint and varnish plant. These kettles, which are 6 ft. 5 in. in diameter, were constructed of 5/16-in. copper sheets. Inside welds were ground flush.

metal melt at the same temperature. The edges of the base metal are melted and mixed with the filler metal to form a homogeneous weld.

Where phosphor bronze is used, the filler metal melts faster than the base metal, hence only a small amount of base metal is melted. The weld is thus composed largely of phosphor bronze, which adheres to the copper.

The procedure is approximately the same in either case, except that a slightly shorter arc is used with the copper filler metal. For low electrical resistance of the welded joint, pure copper filler metal should be used. Phosphor bronze may show a little better ductility in the weld.

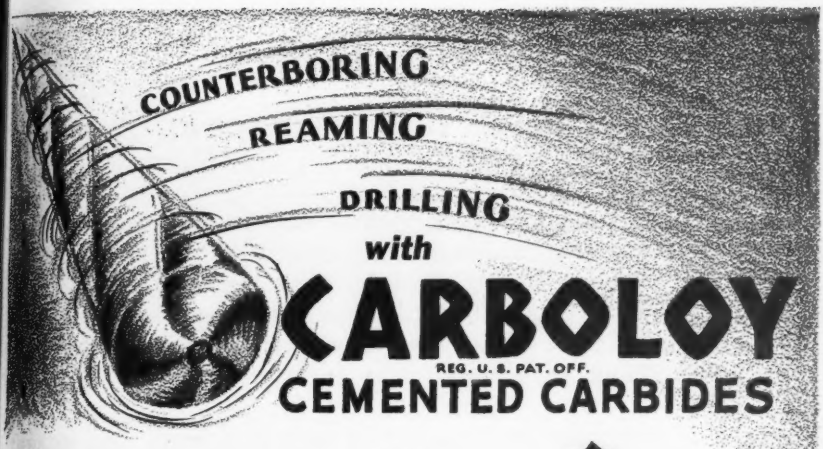
The difficulty with welding copper lies in its very high heat conductivity and in that ordinary copper contains small quantities of oxygen in the form of cuprous oxide. At a temperature under the melting point these oxide inclusions segregate, with the result that the tensile strength is reduced.

The use of the carbon arc with an arc length of ½ inch to 1 inch shields the molten metal and prevents the absorption of oxygen from the air. The vapor in the arc is oxidized to carbon dioxide through exposure to the air. This gas is not absorbable by copper.

By using a carbon arc and very high welding current, heat is supplied to the weld areas faster than it is conducted away; thus the metal is quickly melted.

The best practice calls for the welding to be done in a downhand position. It is always best to have a backing for the joint. Heavy copper, carbon or graphite blocks may be used for this purpose. For butt joints, shallow grooves are provided in the backing strip under the weld.

Copper plates under $\frac{3}{16}$ inch in



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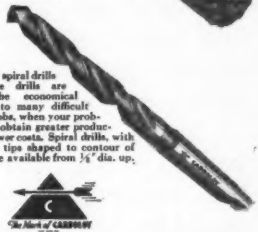

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. . . . and how they are speeded up

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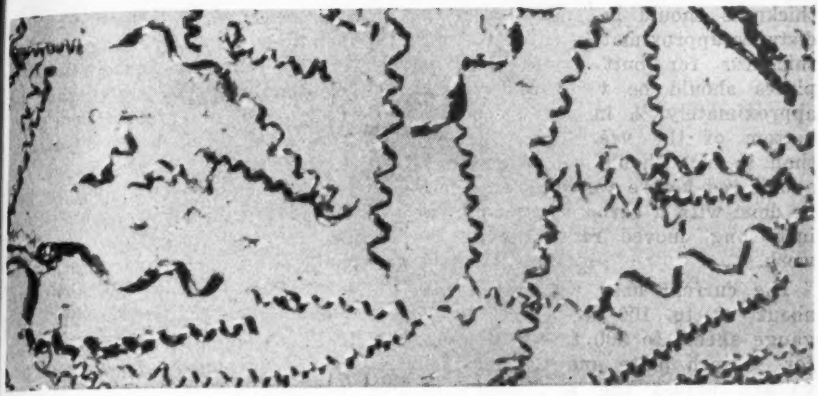
Did you think that such a plain every-day tool as a File couldn't be improved? A lot of other people thought that way, but not so with SIMONDS, No, indeed. In these days of airflow autos and streamline trains, tools also can be speeded up. The new RED TANG is "the File that is speeded up."

Simonds has been in the business of making cutting edges of steel for over a hundred years. We make Circular and Band Saws for cutting wood or metal. Our Inserted Tooth Metal Cutting Saw is an outstanding leader in the field of metal cutting. Twenty-eight years ago we began the manufacture of Files.

Our File Factory employs only a few hundred workers, but truly in it some unusual developments in File Quality have been made that perhaps could not have been made elsewhere. Among these, we found file users could not always be sure of getting files without a very slight twist so we made them uniformly straight. In many files in use we found that the hardness varied so we checked Simonds Files and guarantee uniform, even hardness from end to end on both sides.



Enlarged photograph showing how RED TANG File chips roll off in coils as they do from a cutting tool on a lathe.

We found file users not getting the results they should expect because of the shape of the teeth in the files they were buying. We turned to our experience as Metal Cutting Saw makers and made a file tooth that's similar to a metal saw tooth.

All this took time, new machinery, new methods, and a lot of honest-to-goodness hard study and thinking,- but the result was and is a file that is the least expensive for shop use because of its extra long wearing and fast, accurate cutting qualities.

This is the RED TANG File. The tang of the file is painted a brilliant Red and this is Simonds registered trademark. Any other color would mean some other file but RED helps you pick at a glance genuine first quality, money-saving files. They are sold by leading Supply Dealers. Tell your Dealer you want to try the new Simonds RED TANG Files.

SIMONDS SAW AND STEEL CO.
Established 1832 -- Fitchburg, Mass.

thickness should be spaced apart a distance approximately equal to their thickness for butt joints. Heavier plates should be vee'd and spaced approximately ⅛ inch apart at the bottom of the vee. Plates heavier than ⅜ inch should be preheated to a dull red before welding. This may be done with a carbon arc about one inch long, moved rapidly over the work.

The current used will vary from about 90 to 100 amperes for 16 gauge sheets to 300 to 400 amperes for ¼ inch plate and heavier. The voltage across the arc should be 35 to 50.

The phosphor bronze or copper filler metal is held in contact with the work at an angle of 5 or 10 degrees and with the carbon played on it at a right angle to the rod. When this method is used, very high speeds can be obtained. In fact, the higher the welding speed, the better the weld in most cases. The resulting welds will have a tensile strength of 30,000 to 34,000 pounds per square inch and good ductility. Very little, if any, trouble is experienced from warping.

Some users report satisfactory welds with the metallic arc using phosphor bronze or Everdur electrodes. This method is more successful on thin sheets than on heavy sheets. Using reverse polarity, satisfactory results can be obtained. The difficulty lies in the control of the heat.

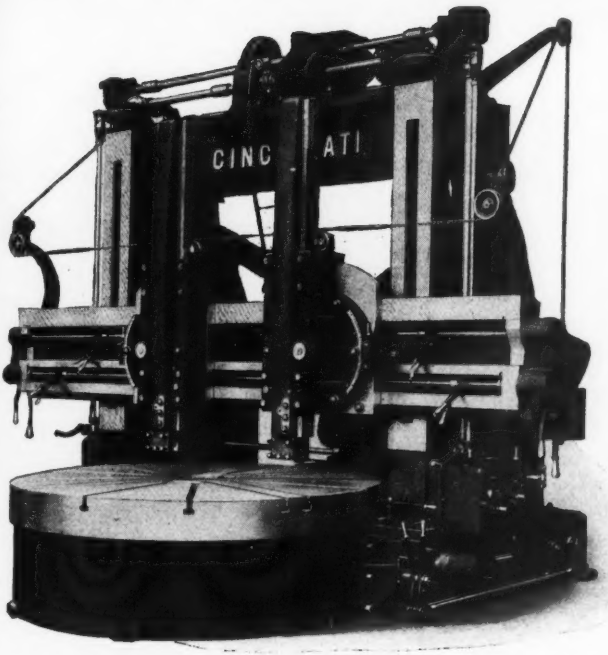
The Matt-Corcoran Company of Louisville, Ky., recently completed a very interesting alcohol still for the United States Industrial Alcohol Company, of New Orleans. This still, part of which is shown in Fig. 1, is built of $\frac{3}{16}$-inch copper plate. It was arc welded by the Electric Welding Company, using the carbon arc process with ¼-inch phosphor bronze filler metal. Welding was done with a 400-ampere Lincoln welder.

The manufacturer states that arc welding is 10 times faster than riveting and that as much work was done by one man in 13 minutes as was formerly done by two men in half a day. Test samples were pulled and showed tensile strength of 31,000 to 34,000 pounds per square inch. The job was completed without warpage, without burning, and without leaks.

In Fig. 2 is shown another example of copper welding. These are two copper cooking kettles built for the Cook Paint and Varnish Company, Kansas City. The kettles are 6 feet 5 inches in diameter and 38 inches deep. They are built of $\frac{5}{16}$-inch plate. One ¼-inch opening was left at the joints and a heavy copper backing used. With a carbon arc and ¼-inch phosphor bronze filler metal rods, the welding was completed rapidly. Welds were ground flush on the inside.

These kettles are believed to be the first of the kind ever to be constructed by arc welding. Such examples are typical of the work being done today. Not only can copper be welded to copper, but copper and its alloys may be welded to iron and steel with strong, ductile joints.

It should be mentioned that in arc welding copper, it is essential to have a welding generator of sufficient capacity and one which will produce a steady current. With 40 volt, 300 to 600 ampere machines, practically any type of copper equipment may be arc welded.



Get the Facts on . . .

The Cincinnati Boring Mill

ANY USER of the Cincinnati Boring Mill will tell you that it is a thoroughly modern tool. Incorporated in its design are modern features which improve your production and cut your costs. Some of these features are:

Centralized Control—All control levers are operated from one central position.

Rapid Power Traverse—Speeds up production without additional physical effort.

Feed Gear Box Mechanism—Is entirely independent for each head. There are eight feeds provided.

All Gears and Racks are of Steel—To insure long, dependable service and low maintenance costs.

Built in various sizes from 5 feet to 12 feet to meet all requirements.

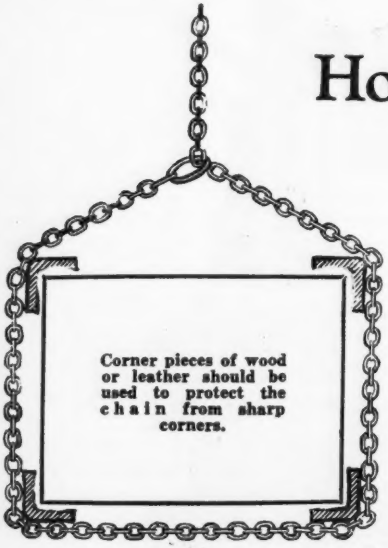
WRITE FOR BULLETIN

THE CINCINNATI PLANER COMPANY

100 SOUTH STREET CINCINNATI, OHIO

How Safe Is Your Sling Chain?

By David Fliegelman



THE sling chain is a comparatively insignificant piece of shop equipment, yet the very nature of its task makes it highly important from the standpoint of safety. A considerable amount of damage to expensive machinery, to say nothing of human physical injury or the loss of life, may result from the breaking of a sling chain or through its letting go of its load.

The important thing about a sling chain is that it must be safe. If a chain shows a sign of a defect, it should not be used. That "a chain is only as strong as its weakest link" is an old story to everyone, yet there are many accidents every year due to defective chains. Added to this number are, of course, the accidents resulting from carelessness or inefficiency in slinging the chain about the work so that it can be picked up by the crane.

American industry has become sufficiently "safety minded" so that it is becoming a matter of routine in most plants to have the equipment and plant accessories inspected at regular intervals by a safety officer or safety committee. In making a safety survey the sling chains should not be overlooked. A sling chain may appear to be harmless and above suspicion while actually it is a potential source of danger. As a matter of fact, the selection of sling chains should be assigned to some one who is capable of judging whether or not a chain is safe for the work for which it is intended, and who can instruct all cranehelpers as to the best methods of hooking onto loads.

A chain should never be overloaded; a chain has its breaking point just the same as any other accessory or material. Chains should always be kept straight; that is, not twisted when being wrapped about a load. Even when not overloaded a kink or twist in the chain or a sudden shock or jolt, either in hoisting or lowering, may elongate and weaken a chain. The sudden application of a load may increase the stresses in a chain to the danger point. The same applies to the method of slinging a chain so that it hooks together at an extremely wide angle.

Attached is a table giving the loads that can safely be carried by single and double sling chains. Particular

Sizes of Sling Chains for Given Loads

Load in Pounds	Single Sling Inches	Double Sling Inches	Load in Pounds	Single Sling Inches	Double Sling Inches
1,125	1/4	----	22,400	1 1/8	7/8
1,700	5/16	1/4	28,800	1 1/4	1
2,700	3/8	5/16	34,500	1 3/8	1 1/8
3,450	7/16	3/8	40,800	1 1/2	1 1/4
4,300	1/2	3/8	46,000	1 5/8	1 1/4
5,500	9/16	7/16	52,500	1 3/4	1 3/8
6,900	5/8	1/2	58,500	1 7/8	1 1/2
8,500	11/16	9/16	66,000	2	1 5/8
10,100	3/4	5/8	74,400	----	1 5/8
12,200	13/16	11/16	84,000	----	1 3/4
14,000	7/8	3/4	93,600	----	1 7/8
18,000	1	13/16	107,000	----	2

Note: Sizes of Double Sling Chains are based on the assumption that the angle betwe the two legs is not over 75 deg., and that approximately one-half the load is carried by ea leg. If these conditions are exceeded, a heavier size of chain should be used.

attention should be paid to the "note." The legs of a double sling chain should be comparatively long, so as to keep the angle between them as small as possible — preferably not more than 75 degrees. The greater the angle between the two legs, the greater will be the stresses in the links for a given load. For a given size of chain, the greater the angle, the smaller the safe load. And if possible, the load should be evenly distributed between the legs.

When wrapping a chain around a casting that has sharp or rough corners, fit the corners with protective pieces of scrap leather or old rubber belting, or even with pieces of wood. Otherwise to the stress of the dead weight is added a shearing stress, set up where the corner of the piece is in contact with the chain.

The life of a chain can be lengthened materially by keeping the chain clean and free from grit. Also, by keeping it clean, any defects may quickly and easily be seen, where otherwise they would escape attention. It is a good idea to oil th chain at regular intervals; oil pre vents rust and prolongs the life o the chain.

Buyers and users of sling chain should remember these three points First, buy good chain. Second, neve overload it. Third, give it regula and careful inspection.

Following are some "Don'ts" fo chain users.

1. Don't use a chain unless it ha been carefully inspected and teste for the work for which it is intende

2. Don't overload a chain above it rated safe-load capacity.

3. Don't use a chain that show excessive wear, or that has bee stretched by overloading, or tha shows deformed links, poor welds, o other physical defects.

4. Don't apply the load to th chain suddenly.

5. Don't twist the chain or ti knots in it, especially if the load i heavy.

6. Don't fasten a chain around sharp corners or edges.

7. Don't force hooks into place by hammering, or allow the load to be carried by the point of the hook.

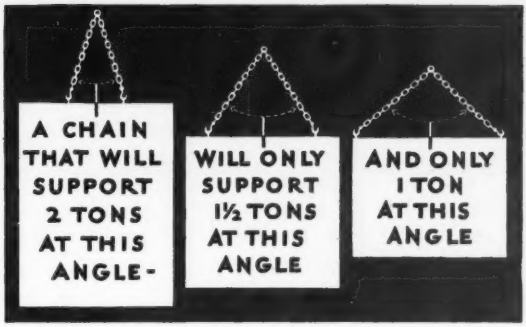
8. Don't spread the legs of a double sling chain any more than is necessary.

9. Don't wrap a chain so that one leg of the chain carries more than its share of a heavy load.

10. Don't allow the chain to become dirty and rusty.

11. Don't take chances; make sure that the chain is properly wrapped and that it cannot slip.

12. Don't forget to have the chain inspected regularly.



The safety limit is reduced in direct proportion to the angle of spread of the chain "legs".

Cogsdill Catalog No. 6

The complete line of precision metal-cutting tools manufactured by the Cogsdill Manufacturing Company, 6511 Epworth Blvd., Detroit, Michigan, is described and illustrated in Catalog No. 6, which has been issued by this firm. The catalog is 5¼ x 8 inches in size, and contains 92 pages of descriptions and engineering tables and data.

The book contains listings of the Cogsdill "Black Panther" high speed twist drills, three and four-groove drills, shell drills, double drills, double diameter drills, center drills, hand and machine reamers of all types, both solid and shell, taper pin reamers, expansion reamers, counterbores, lathe mandrels, spiral and straight end mills, both solid and shell, tooth rounding cutters, and special cutters. Included also is a description and illustrations of the "Bearingizer"—a tool that is being used successfully in many plants to burnish both internal and external surfaces.

Copies gratis to mechanical executives.

Chains and Sprockets for Power Transmission—Conveying and Elevating. A book by this title, dealing with the use of chain and sprockets for the transmission of power and for use in operating conveying and elevating machinery has been published by the Baldwin-Duckworth Chain Corporation, Springfield, Mass. In addition to the usual catalog descriptions of regular and special chains produced by this company, the book contains valuable engineering information on how to determine correct chain drives, arrangements of sprockets, center distance and alignment, tension and slack, lubrication, and other factors necessary to the design and installation of chain drives of all sorts. Horsepower graps covering pitch and number of teeth and type of chain are also included. A copy of the catalog can be had upon request.

QUIET OPERATING MOTORS.—A four page illustrated leaflet entitled Quiet Operating Motors has recently been issued by the Westinghouse Electric and Manufacturing Company. In buildings such as schools, churches, hospitals, hotels, apartment buildings, libraries, and in many parts of large public buildings it is essential that there be no objectionable noise. This leaflet describes the method of individual testing of these motors for quietness, their distinctive features, construction, application and control. Copies of the publication may be obtained from the nearest district office or direct from the advertising department, East Pittsburgh, Pa.

Duplex Two-Stage Horizontal Compressors, made by the Gardner-Denver Company, Quincy, Ill., are described and illustrated in Bulletin HAC-36 which has been issued by this firm. Copies may be secured from the Quincy office.

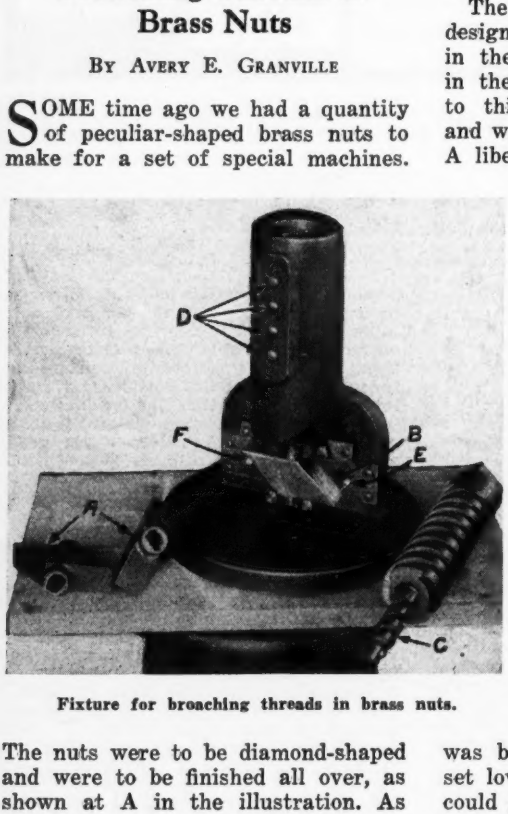
IDEAS FROM READERS

This department is a clearing house for ideas . . . If there is a "kink" or short cut in use in your shop, send in a description of it . . . Each one published will be paid for.

Broaching Threads in Brass Nuts

By Avery E. Granville

SOME time ago we had a quantity of peculiar-shaped brass nuts to make for a set of special machines.



Fixture for broaching threads in brass nuts.

The nuts were to be diamond-shaped and were to be finished all over, as shown at A in the illustration. As they were of comparatively large size, the finishing presented no real problem, but the cutting of the threads had us "stumped." The thread in each nut was to be 1 inch in diameter, 3 inches long, and cut double with ½-in. pitch and 1-in. lead, one-half of the regular depth

The solution was reached in design of the broaching outfit sho in the illustration. A nut is sho in the fixture at B. The nuts ca to this operation finished all o and with the hole drilled and rea A liberal tolerance made it unnec sary to bore the hole; or nary drilling and reaming ing considered sufficient. use, the nut to be threa was placed in the fixture shown at B and the doub lipped helical broach sho at the right was forced d through the reamed h The hardened pilot C on end of the broach was m a snug fit for the rea hole in the nut and threaded master guide w cut to the same lead a pitch as the broach, but w made 3½ inches in diamet The squared end of the m ter guide afforded a g grip for a large double- wrench or lever.

To afford the necessa rigidity, the broaching fix was bolted solidly to a heavy ba set low enough so that the operat could get the proper leverage on t long handles of the wrench wh forcing the broach through to cut t thread. An unique feature was th threads were not cut in the sle of the fixture for the master gui to work in, but four hardened a ground steel pins, indicated at

were set into each side of the sleeve. The eight pins acted in the manner of an internal thread, projecting into the sleeve and engaging the threads of the master guide.

A taper shank was provided on the broach, to fit a taper socket in the lower end of the master guide, so that it could easily be removed for sharpening. The cutting lips were ground with only a slight angle on the edges, and were slanted just enough to throw the chips into the grooves of the broach.

Since the threads in the nuts were cut only half as deep as usual, the work of forcing the broach through the piece was comparatively easy. However, owing to the tendency of the work to twist as the broach was forced through, it was found necessary to clamp the nuts to the face of the fixture, which was done by placing a strap across the nut and bolting it to the fixture with two capscrews, inserted into the threaded holes E and F.

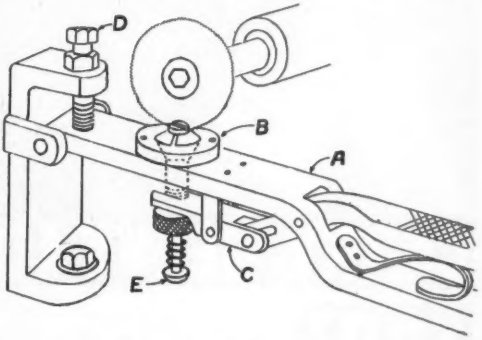
Simple Fixture for Slotting Screws

By Chas. M. Willey

THE processing of parts in small lots is usually a slow and expensive operation, and this applies as well to the slotting of screw-heads. The setting-up of a cumbersome high-production fixture is usually too costly for a small lot, yet the hit-and-miss method of trying to work with a vise or other common tools is unsatisfactory. The best way is to make up a simple, but inexpensive, fixture.

The drawing shows a simple but quick-acting fixture for slotting screw-heads, made to process one piece at a time. The building of such a fixture does not involve any great outlay for material, and can be made in comparatively short time. It is surprising, however, to see how fast it can be operated.

The best machine with which to use this fixture is the bench lathe, using a small saw on an arbor that will fit into the headstock spindle. The lathe collets will be used to hold the screws in the fixture. The drawing shows the design quite clearly, omitting dimensions. The device consists essentially of a hinged arm A upon which is mounted the collet holder B. The collet projects downward through the collet holder and is engaged by the forked end of a toggle lever C which is operated by a plier grip handle. A nut on the collet prevents the toggle lever from slipping off the collet, as shown. A depth stop D may be set to prevent slotting the screw head too far, and a spring rod E serves as an ejector.



Simple Fixture for Slotting Heads of Screws

To load, the hinged arm is swung down and out of the way of the saw, then a screw is inserted into the collet. The arm is then raised to the correct height as indicated by

the depth stop and the sawing action is completed. As the arm is lowered again the collet opens and the spring rod drives the screw upward and out of the collet. The entire operation can be performed in a few seconds.

Another Welding Kink

By Arthur H. Sandell

A little welding kink that does not seem to be as well known as it should be is illustrated by means of the photographs herewith. When a

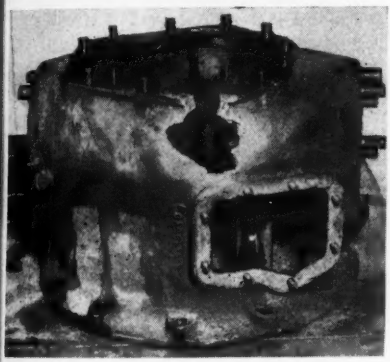


Fig. 1—Aluminum casting with piece completely broken out of the side.

piece is broken out of an aluminum casting, as shown in Fig. 1, it is often easier to reconstruct the wall with new metal than to try to weld in a piece. The new metal can be built in without difficulty if a retaining wall, composed of a piece of sheet asbestos, is braced or clamped in position as shown in Fig. 2. The asbestos must be braced so that it will be leak-proof, otherwise the molten metal will filter through and run away.

With the asbestos retaining wall in position, the work is propped up

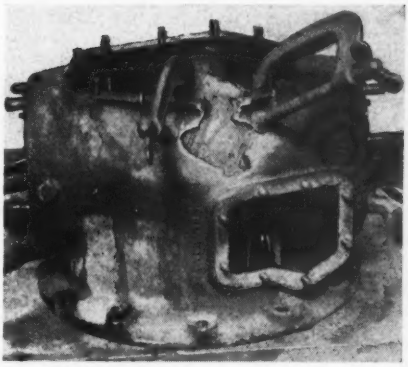


Fig. 2—Piece shown in position for welding, with sheet of asbestos clamped in position to serve as retaining wall for the molten metal.

to bring the hole as nearly level as possible to prevent the metal from flowing too much toward one side and running out, and to make it easier to puddle the molten metal. Cases will be found in which it will be well to build a dam of fireclay across the open part of the break so as to leave as little metal to dress off as possible.

The finished piece, with a built-up boss for a bolting stud, is shown in Fig. 3. The finished job is undoubtedly as strong and as serviceable as when the piece was new.

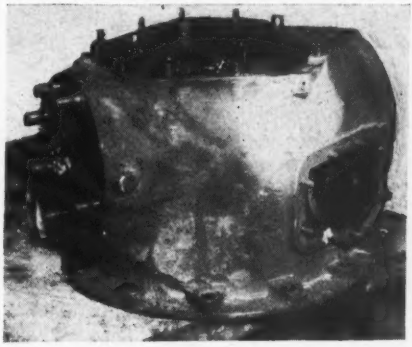
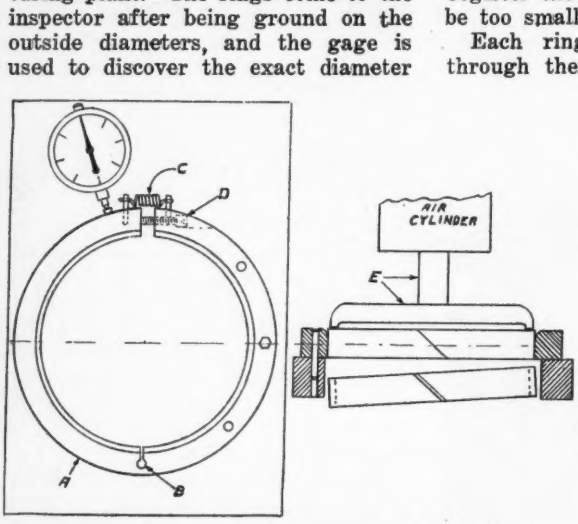


Fig. 3—The finished weld.

Inspection Device for Piston Rings

By Charles Kugler

THE drawing illustrates the design of a device for checking the dimensions of piston rings, as used in a large piston ring manufacturing plant. The rings come to the inspector after being ground on the outside diameters, and the gage is used to discover the exact diameter of the ring under inspection.



Design of device for testing diameters of piston rings.

The gage proper consists of a steel ring A, which is drilled and sawed at the point B so that it will spring under slight stress. This ring is bolted and dowelled to a surface plate, directly over a hole in the plate which is approximately ⅛ in. larger than the outside diameter of the ring. A spring C draws the ends of the gage together at the opening, and a filister head screw D serves as a stop. By adjusting this screw, the gage can be set to inspect any size of ring within certain limitations. The upper edge of the ring is rounded so that a piston ring can easily be slipped into it.

Also anchored to the surface plate is a dial indicator, so located that the plunger contacts with the free end of the ring, as closely to the spring as possible. By using a ring of correct size as a guide, the indicator can be set so that, as the ring is pushed through the gage, it will register the amount that a ring may be too small or too large.

Each ring is pushed completely through the gage, the pressure being applied by means of a flat plunger on the end of the piston rod of an air cylinder E. To the valve which controls the air supply to the cylinder is attached a rod that connects with a foot lever; thus by pressing down on the foot lever, the operator opens the valve and the plunger is projected downward. As she lifts her foot a spring raises the foot lever and the valve is reversed, thus withdrawing the plunger.

Thus the operation of inspecting the rings is very simple; the operator places a ring in the gage, then presses the foot lever and pushes the ring through the gage, watching the indicator as she does so so as to note the size of the ring. She catches the ring with the free hand as it drops after being pushed through the gage.

A Drawing "Kink"

By L. G. Patterson

A shop "kink" that was developed in our press department may be of use to some of the readers of

Grinding . . a result of fitting NORTON WHEELS

NE WHEEL WORK
NOTHER?

d bond, grain and grade must of course t there is another important factor—the of abrasive, bond and pore space. Nor- his arrangement—the wheel structure—to best grinding action for each job.

BE DEFINITELY

cial Norton process of manufacture makes o vary the structure by definite steps just and grade. The different structures are by numbers—from No. 1 for close spac- s to No. 12 for open spacing.

UCTURE CHANGES

experience shows that a one-step change is often the whole difference between failure of the wheel.

R SPECIAL
ES?

ype of bond, known as "B" bond is an actor on all jobs where steels and steel ing ground. Less "B" bond is required a given grade of wheel—the result is a grinding action.

OMPANY, Worcester, Mass.


Knee Action Spring Rod

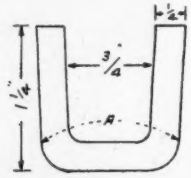

Rear Axle Housing

W-486A

ding Wheels, Pulpstones. Laboratory Ware: Refractories; Porous Plates asive Papers and Cloths. Norton Pike Sharpening Specialties.

MODERN MACHINE SHOP, so I am passing it on to you for what it is worth.

We use the "18-8" stainless steels for a number of the parts that go into the manufacture of our product, and one of the operations on one part is that of bending a piece of ¼-in. round steel to the "U" shape



Drawing illustrating design of part to be formed.

shown in the drawing. This operation is performed in the punch press.

One of the difficulties that we encountered in this operation was that excessive gaulding developed at the points A. In an effort to eliminate this trouble we tried several different drawing lubricants, including white lead and chalk, with no success. The pressure required to bend this material was sufficient to force all lubricant from between the work and the die, allowing the work to pick and gauld. After everything else had been tried without success, we even tried varnishing the pins and forming after the varnish had dried. This worked satisfactorily, but was too expensive as the varnish had to be removed from the parts before they could be used.

As a last resort we tried cadmium plating the pins before forming them, and were more than pleased at the results. Not only was the gaulding eliminated, but the work came from the press with a high polish, and as the cadmium is a corrosion-resistant metal, it did not have to be removed.

Simple Method of Cutting a Barrel Cam

By Wm. C. Betz

IN the rebuilding of a number of special machines we had to have some small barrel cams, each to contain a groove that would impart ¼-inch of travel from the high to the low point. As we had no gearing for our millers for so slight a lead, we had to devise other means for cutting the cam groove. After considering several methods, we used the method described here.

We machined a plate to 8 inches diameter and then faced the sides so that the plate was a half-inch thicker at one edge than at the opposite edge. To this plate we bolted the cam blank, as indicated in Fig. 1. The blank was designed to contain a groove that would be 4 inches in diameter at the pitch line, the pitch line being theoretically half the depth of the groove. When clamped in position, the outer face of the

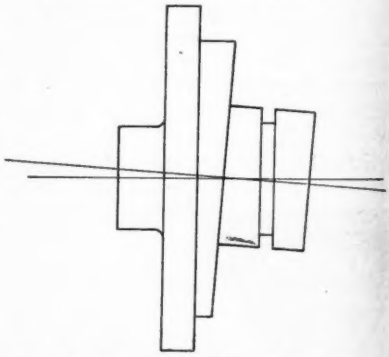


Fig. 1—Drawing showing method of setting up a cam for cutting the groove in a lathe.

cam blank was parallel with the face plate of the lathe and perfectly central. An indicator was used to true up the piece.

The groove was cut with a wide grooving tool which left the faces at the angle of cutting. In other words, when the cam was placed on an arbor on centers and revolved, the cam slot faces changed from one extreme angle to the other. We made up for this angle by making our cam followers barrel-shape, as shown in Fig. 2; thus they bore only on the pitch line which was all that was required.

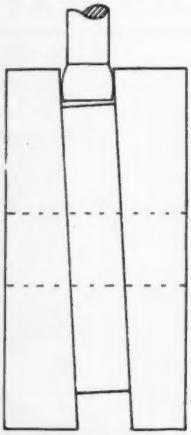


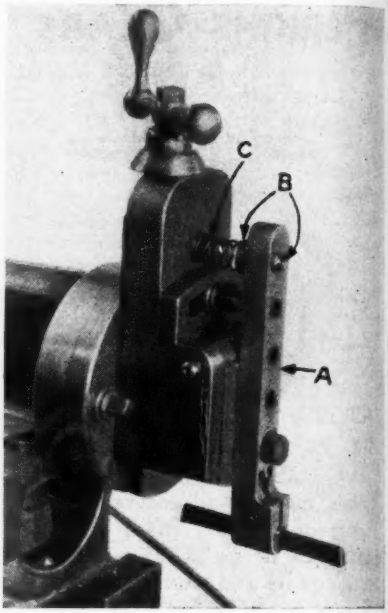
Fig. 2—Cam and follower stud.

Quick-Action Clapper Block for Shaper

By Geo. L. Langford

ALTHOUGH the regular clapper block on a shaper is fast enough for all ordinary purposes, it is hardly fast enough in action for use when finishing the tool-slots in a boring bar, or for similar jobs. Where there is only a small amount of tool-clearance, the back action is liable to wedge the tool and either break it entirely or spoil the work. This difficulty is usually eliminated by the simple expedient of holding the block down by hand. This method, however, means that one hand is constantly employed for this extra task.

To obtain quicker action of the clapper block and at the same time leave both hands free, we arranged the clapper block on our shaper as shown in the illustration. This method, unlike so many others, does not necessitate drilling or tapping into any part of the shaper ram, head, or other part. The tool holder A is simply made a little longer than the usual holder, and a plug



Quick-Action Clapper Box for Shaper

B is provided, which holds the spring C in position. The rear end of the spring butts against the surface of the vertical slide.

The regular tool post is removed and the tool holder is bolted to the clapper box by means of a capscrew and nut.

UNION COLD FINISHED SHAFTING: This 16-page booklet, issued by Union Drawn Steel Company, Massillon, Ohio, contains a treatise on the manufacture of commercial or cold rolled shafting, including the pickling and drawing. The subjects of "physical properties," "straightness," "warpage," and surface finish are covered, with a table of recommended sizes of keyways. The book should be of interest to every buyer or user of shafting. Copy free upon request.

Over the Editor's Desk

The Green Light Is On!

THE editor's page is usually considered the private domain of the editor, to be used for his comments only. But once in a while we run onto something in another magazine that is too good, we think, to be kept to ourselves, and so we pass it on here. Such is a digest of an article by J. S. Shaw, titled "The Green Light Is On", as it appears in "The American Salesman." Here it is.

"There are two ways to get into trouble at a traffic stop. One way is to run through the red light. You are likely to get arrested and be hauled into court to pay a fine.

Another way is to stop for the red light, then fail to notice when it changes. You either get your rear fenders bumped or find the other drivers have all swung around you. By the time you get under way you are crowded out of the front line and trailing behind everybody else as you go down the road.

A few years ago thousands of firms in the United States ran by a red light. They didn't recognize the depression when they approached it. They failed to slow up and ran on through. Before long they found themselves in trouble. They had thought only of expanding, of forcing sales, or spending recklessly, of boosting advertising budgets. Bigger volume, still bigger volume, was the one and only goal. They were going too fast to see the red light. Trouble resulted.

Now, a few years later, many business firms are still steeped in depression thinking. Reduce expenses; be cautious; hold back; don't spend a dollar if it can be avoided. Retrench; play safe! It has become a habit. Like the automobile driver, they fail to see that the STOP sign has changed to GO.

Thousands of firms with this habit of mind are going to find that their competitors have edged past them and are out in front. Thousands of firms in the front rank a few years ago will find themselves bringing up the rear in the days ahead. Those firms which were quick to see the change have stepped on the accelerator. They are out for front place."

Business is accelerating. Are you moving with it, or are you still waiting for the "Go" signal?

Pink Machines Next?

AT intervals during the past several years we have commented upon the use of color on machine tools. The tendency has been toward the use of colors that would show the dirt and oil, rather than to hide it, and the practice is commendable from every standpoint. However, we notice from a British journal that, in line with the "brighter mills" movement, a Lancashire textile manufacturer has equipped his weavers with green uniforms and has baskets of flowers distributed throughout the mill regularly to brighten the atmosphere.

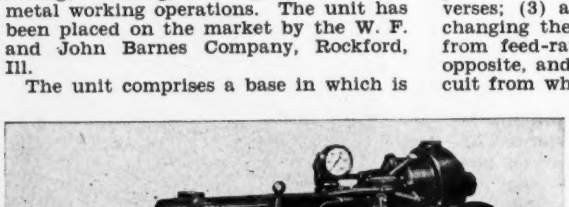
If the movement spreads, it is going to be tough on the crane operators. "Don't set that crate of castings down there, Harry; you'll knock over those daffodils."

NEW SHOP EQUIPMENT

Barnes Square Ram Hydraulic Drill Unit

The Barnes Square Ram Hydraulic Drill Unit, shown in the illustration, is a complete, compact, powerful, self-contained machine tool unit for drilling, boring, reaming, milling, and similar metal working operations. The unit has been placed on the market by the W. F. and John Barnes Company, Rockford, Ill.

The unit comprises a base in which is mounted a standard electric motor and a square ram which has a stroke of 12 inches, together with the Barnes Hydraulic Feed Cycle. Mounted in ball bearings in the square ram is a spindle which is driven by the electric motor through pick-off gears. A socket in the spindle-nose provides for driving either a single cutting tool or a multiple spindle head which can be bolted to the flange on the end of the ram.



Barnes Square Ram Hydraulic Drill Unit

The unit can be operated in any desired position or at any angle. It can be mounted on existing machines, or incorporated in a new design. Units can be operated in combination with either independent or centralized control.

The Barnes Hydraulic Feed Cycle provides rapid approach of tools to the work at a fixed rate of feed, with easy adjustment to any desired feed-rate whatever between zero and the maximum for which the cycle is designed, accurately-controlled dwell, if required, rapid return of tools to starting position, automatic stop, or repeat. These features are secured through (1) an adjustable volume pump which supplies oil at high pressure for feeding tools in the work; (2) a constant-volume pump which supplied oil in large quantities for rapid traverses; (3) a control valve for instantly changing the movement of cutting tools from feed-rate to rapid traverse or the opposite, and (4) a closed hydraulic circuit from which the air is entirely eliminated.

The units are connected by a minimum of piping, without by-passes. This arrangement maintains an absolutely constant ratio between the feed-rate and the r.p.m of the cutting tools under all operating conditions. The Barnes patented high-pressure feed pump is said to be simple, compact, durable, adjustable, and highly efficient. It provides a smooth, uniform hydraulic feed which eliminates chatter. The constant ratio of feed per revolution of the spindle is maintained regardless of the resistance encountered by the cutting tool. Feed rates are infinitely variable within the range stated in the specifications.

The operating mechanism is housed in a rugged base. The large, square ram is mounted in a long bearing that is adjustable for wear. The hydraulic cylinder is accurately honed and fitted with close-fitting piston and rings. A flexible coupling connects the driving motor and geared transmission of power to pumps and spindle.

The motor can be any standard squirrel cage motor from No. 254 up to NEMA maximum. The spindle speeds available are, with 1200 r.p.m. motor, 92 to 750 r.p.m.; 1800 r.p.m. motor, 138 to 750 r.p.m. Maximum stroke, 12 inches. Capacity, and operation or group of operations requiring 5 h.p. or less. Weight, including motor, skidded for domestic shipment, 1200 pounds.

Rockford Hy-Draulic Shaper

The advantages of hydraulic power have been utilized in the design of the Rockford-Hy-Draulic Shaper, which has been brought out by the Rockford Machine Tool Co., 2400 Kishwaukee Ave., Rockford, Ill. The machine, shown in the illustration, is of strong, rigid construction and designed for simplicity of operation. Controls are centralized, and the simplified operating adjustments are made without the use of tools.

The ram is driven by hydraulic power, the hydraulic unit being located in the base of the machine. The unit is driven by a standard end-mounted motor, as shown.

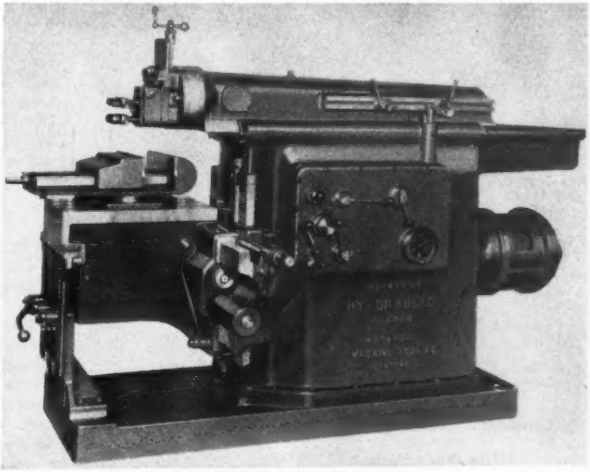
The shaper has an unlimited range of instantly adjustable speeds and feeds up to the maximum indicated in the specifications, and is said to have higher return speeds than have ever before been available in commercial shapers.

The Hy-Draulic stroke control is extremely simple and convenient. A pair of dogs governs both the stroke and length and its position relative to the work. Conveniently mounted in a T-slot on the ram, the dogs can be adjusted quickly and safely by hand while the ram is in motion, no tools being required. Altering the stroke length does not change the cutting speed. The direction of ram travel can be reversed instantly at any point, even when the ram is taking a heavy cut.

The number of feeds is unlimited up to the maximum, and any feed within the range of the machine can be selected instantly. The feed mechanism is independent of the ram-drive. It has few moving parts, a large safety factor, and small power consumption. The feeds can be adjusted while the ram is in motion.

The ram is driven by a smooth flow of oil under tremendous pressure, the oil pressure also acting as a shock absorber when the tool enters the cut or meets a hard spot in the work. The control is positive, however, making it impossible for the ram to "run away" as the cut diminishes. As there is no jar whatever in the drive, cutting edges of tools are conserved and smooth finishes are obtained.

The application of the power is direct; thus the maximum efficiency is obtained. Weight is transferred from the moving to the stationary parts, thus increasing the strength and rigidity.



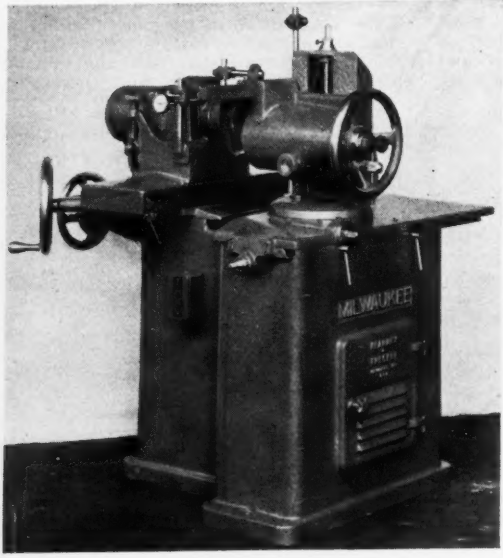
Rockford Hy-Draulic Shaper

All feeds and rapid traverses are controlled by a single lever. A micrometer stop is provided for the cross feed to save time and increase production. The table support is clamped or released by a single lever.

The machine is made in two sizes, 16-inch and 24-inch. The stroke of the 16-inch machine is 17 inches, and the 24-inch machine is 25 inches. Each has a minimum stroke of 1 inch. The 16-inch machine has a range of cutting speeds from 0 to 144; the 24-inch machine, from 0 to 120. Table travel, horizontal, 16-inch machine, 16 inches; 24-inch machine, 20 inches. Cross feeds, either machine, from 0 to 0.250 inch. The 16-inch machine takes a 5 h.p. motor; the 24-inch, a 10 h.p. motor. Speed of motor, either machine, 1200 r.p.m. The net weights, less motor are 4200 pounds and 6300 pounds respectively.

Milwaukee Face Mill Grinder

A new Milwaukee Face Mill Grinder, basically designed for the rapid sharpening of Tungsten and Tantalum Carbide milling cutters, has been announced by Kearney & Trecker Corporation, Milwaukee, Wisconsin.



Milwaukee Face Mill Grinder

The Milwaukee Face Mill Grinder is a heavy-duty machine with capacity to sharpen all face milling cutters up to 16 inches in diameter. Throughout the entire machine there is extra metal and extra strength in every member. The bed is large and heavy. All sliding surfaces are broad and fully covered and protected to prevent wear. The spindle wheel housing and slide form a compact, rigid unit.

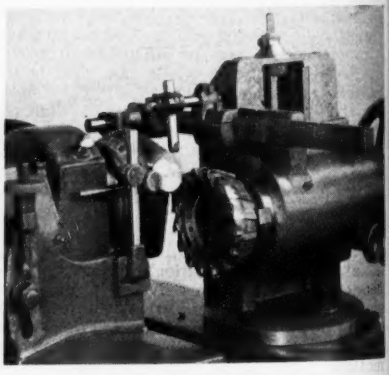
The cutter spindle is large in diameter and mounted on Timken roller bearings. It has the No. 50 national standard spindle nose, the same as the milling machine, so that any cutter mounted on a Style "C" arbor can be sharpened without removing the arbor. This method eliminates chance of error. Larger diameter cutters are bolted on to the spindle nose so that adapters are unnecessary. The cutter spindle housing is large in size and is mounted on a rugged upright that can be swiveled to any desired angle.

Graduated dials on all adjustments screws make setups simple and accurate. Every control is handy for the operator so that no time is lost.

A Federal jeweled-bearing dial indicator, reading to half-thousandths, is furnished as standard equipment. The indicator is permanently mounted on the wheel spindle slide directly in front of the operator. With this indicator it is possible to quickly check the accuracy of the finished cutter, as well as to check the cutter before grinding to see if it has been run too long and become wastefully dull.

The wheel spindle is large in diameter and mounted on three anti-friction bearings. The massive 55-pound flywheel is solidly mounted on the spindle between front and center bearings.

Because of the unusual hardness of Tungsten Carbide, the ordinary cutter-grinder has a tendency to slow down when the abrasive wheel comes into contact with the carbide tip, causing excessive wheel wear and making it a long tedious operation to uniformly sharpen every blade. The inertia of the flywheel provided on the Milwaukee spindle keeps the abrasive wheel running smoothly and maintains a uniform speed at all times. The effects are

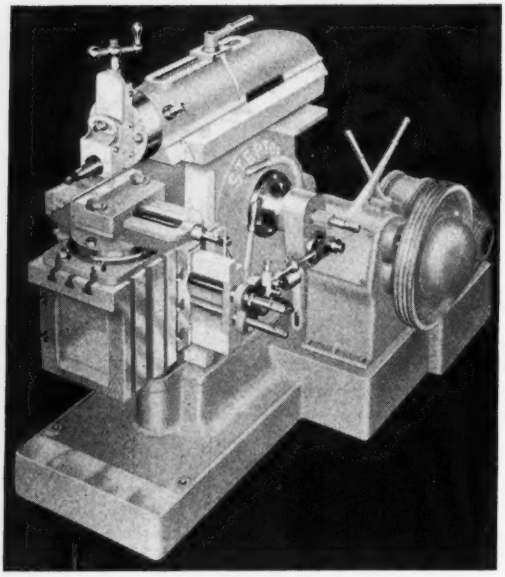


Grinding Carbide-Tipped Cutter

three fold: There is less wheel wear, a uniform amount of stock is removed from each blade, and the time for completely sharpening a cutter is greatly reduced.

A complete blower system can be furnished as an integral part of the machine for use in plants where a central exhaust system is not available. This equipment consists of a motor exhaust fan fully enclosed in base of machine, flexible hose connecting to wheel hood, and separate compartment in base for collecting dust.

The machine will sharpen all face mills up to 16 inches in diameter. It is provided with a one horsepower, reversible motor and three position push button control—start, stop, and reverse. The machine requires a floor space of four by six feet and weighs 2750 pounds.



Steptoe 16-In. Back-Geared V-Ram Shaper

Steptoe 16-in. Back-Geared Shaper

The illustration shows the Steptoe 16-in. Timken bearing equipped V-ram shaper which has been brought out by the Western Machine Tool Works, Holland, Michigan. The shaper is arranged for Texrope motor drive through the speedbox.

The complete line of Steptoe shapers, ranging in sizes from the 14-in. single gear to the 24-in. back-geared shaper, are all now designed with V-rams. The Steptoe shaper has an extra large head, designed to swivel through an arc of 120 degrees. Bronze and felt retainers keep the ways of the machine cleaned and oiled at all times.

A feature of the machine is the "fingertip" control feed mechanism, which is incorporated in the centralized control. Each machine is equipped with Timken roller bearings, reducing friction to the minimum and providing means for keeping the bearings properly adjusted for quick action, smooth operation, and accuracy. The speed-box is arranged with a twin disc clutch, providing for sure and smooth engagement and release. A one-piece solid rocker arm block is incorporated in the design. The machine is so built that it will operate efficiently at a ram-speed of 130 strokes per minute.

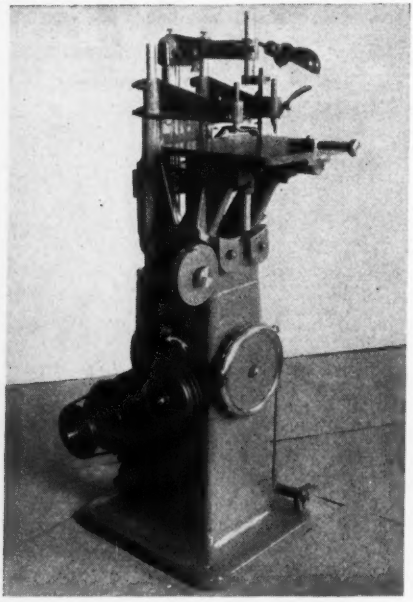
The machine can be equipped with a forced feed continuous lubricating system, including the pump, Pur-O-Lator and pressure gauge.

Oliver Heavy Duty Filing Machine

The Oliver Instrument Company, 1400 E. Maumee St., Adrian, Michigan, has announced the Oliver Improved Heavy Duty Die Making Machine shown in the illustration. The machine is equipped with every tool and attachment thus far devised by this firm for the rapid production of dies and similar work.

Six speeds are provided at even intervals between 100 and 300 strokes per minute, the stroke being adjustable from 0 to 5 inches. The machine has a capacity for sawing or filing in metal up to 3 in. in thickness and filing heavier material when the stroke is shortened. Any type of parallel file or any size of saw from the smallest to heavy machine saws can be held in the clamps without any previous preparation.

The cutting tool is reciprocated by a ram made of 2-in. steel tubing and having 10 inches of bearing. The arms that hold the tool are of rigid construction and are provided with universal clamps



Oliver Heavy Duty Filing Machine

that are adjustable vertically so that the file or saw may be held close to the work. The upper arm is hinged and provision is made for straining the saw. This arm may be turned back for easy removal of the work or can be removed entirely if desired. Saw guides are provided above and below the table, and are easily adjusted.

The table, which is of heavy construction, is 14 inches square and tilts 15 degrees to the front, right, or left, and 5 degrees to the rear. The table is held on a heavy cradle attached to the bed of the machine and there are no swivels or adjusting nuts near the center of the table; thus this location, where the lower end of the file is clamped, is open and easily accessible.

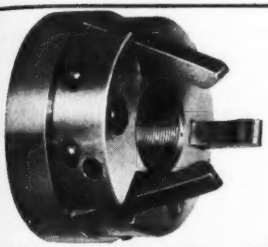
Permanent alignment of the cutting tool is insured by a crosshead at the rear of the machine. The crosshead takes all side strain, and is equipped with adjustable bronze shoes should continued use make adjustment necessary.

A novel feature is the method used to relieve the file or saw on the up-stroke and for feeding the work while filing. It consists of a hydraulic feeding device which provides a constant controllable pressure on the down-stroke of the ram, but relieves the pressure on the up-stroke. There are no ratchets, weights, or similar parts used in this device.

The feeding device is so arranged that it requires the constant attention of the operator to his work; thus work cannot be spoiled by leaving the machine running without attention. The machine is started and stopped by means of a foot lever, providing instant action and leaving the hands free. Power is supplied through a ¾ h.p. motor. All running parts are enclosed in an oil-tight case, and all shafts are equipped with ball bearings.

Pease Model 11 Continuous Blue-Printing Equipment

First-class blue-prints can now be produced at a rate of speed of 12 feet per minute and at a minimum of cost



Three Fingered Equalizing Chuck

Modern equalizing finger holders distribute the load in three places instead of the usual two. The thrust plate is self-adjusting, so that each finger will carry an equal load, reducing breakage to a minimum. Works entirely automatically requiring no care or attention. The Collet and Collet Tube are moved backward or forward in a perfectly straight line, thus assuring that all the locking power is applied directly to the Collet, which means a tighter grip with less power consumption. Increases the life of the fingers a full 100%. Can be used only on machines where the end of the spindle is not slotted such as Gridley Automatics. Write for new catalog No. 31.

MODERN COLLET & MACHINE CO.
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Mfgrs. of all types collets, feed fingers, alloy steel cams, chucking fingers, collet and pusher tubes and various perishable parts for screw machines.

CHAMPION STEEL RACK

Write for Specifications and Prices

WESTERN TOOL & MFG. CO.
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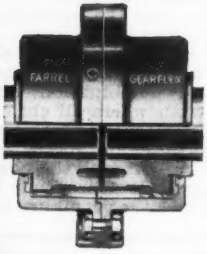
FARREL GEARFLEX COUPLINGS



Sectional View of Farrel Gearflex Coupling showing gear teeth and oil chamber.

16 standard sizes from 2½ inch to 20 inch bores and special designs for individual conditions.

Send for copy of Gearflex Coupling Bulletin No. 437.

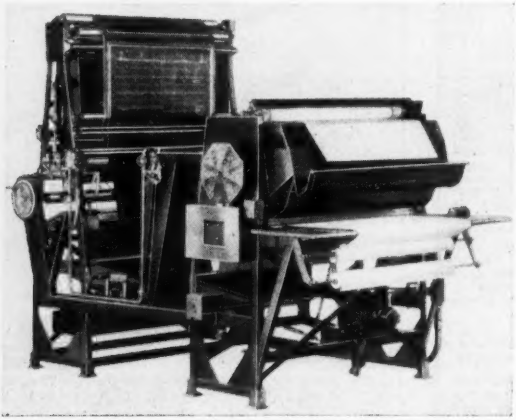
Protect against Stresses of Misalignment and Variable Load

For protection against the troubles that result from misalignment, install Farrel Gearflex Couplings in direct-connected drives. They compensate for parallel and angular misalignment, as well as a combination of the two, and permit free lateral or end float of the connected shafts where such movement is necessary.

There are no parts to wear out or to require adjustment. Operating in oil, dust-proof and moisture-proof, they require no attention except maintenance of the oil at the proper level. Their simplicity, accuracy and rugged construction insure long life and dependable performance.

FARREL-BIRMINGHAM COMPANY, INC.
381 VULCAN ST., BUFFALO, N. Y.

per square foot by the use of the Pease Model "11" Continuous Blue-Printing Machine, product of the C. F. Pease Company, 855 N. Franklin St., Chicago, Ill. The Model "11" machine is said to have been built from the standpoint of the operator. It is easy to feed, easy to run, and an inexperienced operator can readily learn in a short time to handle the equipment efficiently.



Pease Model "11" Continuous Blue-Printing Equipment

The Model "11" Machine is composed of three units—a blue-printing machine, a washing unit, and a potashing and drying unit. The blue-printing machine can be operated independently from the other machines, where required. The Model "11" machine is made in one size only, for paper up to 42 inches wide; it can be furnished on special order, however, for paper up to 54 inches wide. The machine can be wired to operate on either 220 volts direct or alternating current, and is powered with a variable speed ¼-h.p. drive motor with a combination gear and sprocket chain drive, all fully enclosed for safety purposes. The blue-printing machine is equipped with three new-type Pease "Super-Actinic" high power enclosed arc lamps, set at 17 amperes each. The lamps provide a printing speed of 4 inches to 12 feet a minute.

An exhaust fan constantly circulates the air and forces it from the printer, reducing the temperature of the lamp globes and cooling the contact glass. A special gear shift underneath the table feed provides for two speeds and for neutral. A special hand-operated dial located at the right front of the machine and connected by direct shaft to the rheostat mounted on the side frame of the printer provides for instant and accurate change of printing speed for any requirement.

When operating the Model 11 continuously, tracings are laid face up on a roll of blue print paper feeding in at the front of the machine and are carried upward around the contact glass, past the arc lamps. As tracings reach the top of the machine they are automatically returned into a tray at the front of the machine while the prints are carried on through the equipment into the washing, potashing, and drying units.

When printing continuously, prints on the continuous roll of paper pass over into the first combination front and back water wash where all chemicals are removed. They then pass down into the machine over a special chemical roll applicator where the developing solution is applied. The prints are then washed again by a combination front

and back water wash which further removes any surplus chemical from the paper and the paper is then dried.

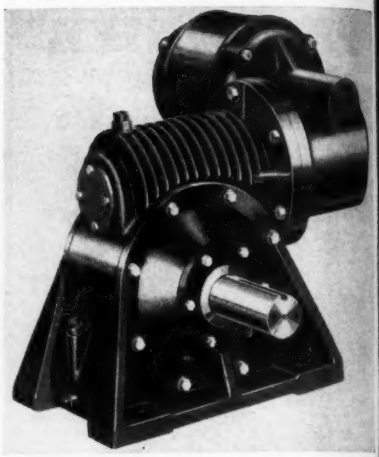
The drying unit is new in both principle and design, and is constructed to provide an equalized distribution of heat and correspondingly more uniform drying of the paper at all times. A special feature of the dryer is a series of rolls which "iron" the paper as, under tension, it travels through the dryer, thus producing flat prints.

The equipment can be equipped with either gas or electrically heated dryer. The "Super-Actinic" arc lamps begin operation steadily and easily and the arc will burn steadily from 45 minutes to 1½ hours without breaking. The contact glass is new in design and larger in area than has been used before on Pease machines.

The framework of the Model "11" equipment is steel, arc welded to combine strength and low weight. All piping and wiring is complete, ready for installation. The equipment is shipped in three sections, each carefully crated and on skids. The sections are interlocking, so that when bolted together, the machine is one complete assembly in perfect alignment. The blue printing machine can be furnished in two sizes: 42 in. or 54 in., and the complete equipment can be furnished in two sizes according to the blue-printing machines.

Janette Double-Reduction Worm Gear Speed Reducer

The Janette Manufacturing Company, 556 West Monroe St., Chicago, Ill., announces a new series of motorized double worm gear reduction units, complementing the present Janett line of power transmission equipment. The new units consist of motors up to 1 h.p., each connected to a train of two worm gear reductions in a wide series of standard available ratios ranging from 96:1 to as high as 8100:1.



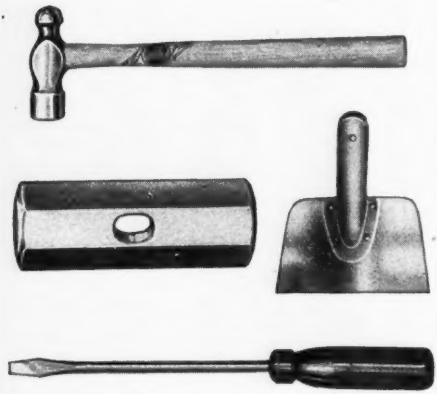
Janette Double-Reduction Worm Gear Speed Reducer

Motors for these speed reducers are available in direct current, single phase, and polyphase types. The motors are ball bearing, and all gear shafts operate on tapered roller bearings. Worms and gears are amply dimensioned for high torque applications and consist of hardened and polished steel worms and bronze gears.

Stanley Non-Sparking Tools

Industries where the operations are such that explosion and fire hazards are ever-present will be interested in the line of "non-sparking" tools that has been brought out by The Stanley

Rule and Level Plant, New Britain, Conn. The tools are non-magnetic and non-sparking, although almost as durable as



Stanley Beryllium Copper Non-Sparking Tools

steel tools of similar design and size.

The working parts of Stanley non-sparking tools are made of hardened, wrought beryllium copper, a new alloy of copper containing 2 to 2½ per cent Beryllium. Beryllium—an element found in certain minerals—imparts to the copper remarkable properties. Beryllium copper can be machined or formed in a soft condition. Heat treating it, however, results in a tough, hard material of high tensile strength. In the production of Stanley non-sparking tools, the heat treatment is varied according to the design and purpose of the tools.

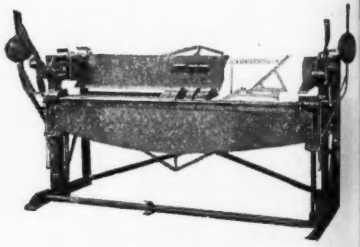
Among the tools made from beryllium copper are floor scrapers, hammers, sledges, cold chisels, drift pins, screw drivers, picks, and so on. Special tools will be supplied upon request.

The Whitney-Jensen Brake

A combined bending brake and pu brake, illustrated herewith, has be placed on the market by the Whitne Metal Tool Co., Rockford, Ill. The ma chine is designed so that it operates th reverse of most bending brakes; the lowe cross rail moves directly up and dow on guide posts properly machined an fitted against a fixed non-movable plate rail. Due to the up and down direc movement, the work does not creep an a second clamping is not necessary.

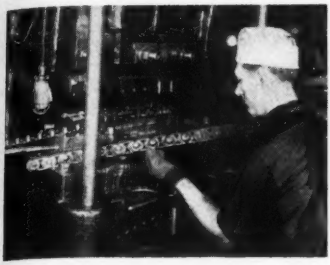
The design includes an exclusive lock ing feature for holding the work betwee the jaws securely tight. The front apro hinge has a hardened and ground wris pin, and the apron also has a side ad justable stop. There is also a rear depth gage. Eccentric levers on either en control the opening and closing of th jaws, allowing a full 2-in. opening whe the lever is fully released. The eccentri lever is moved only the required distanc to release the work.

The compression springs do the lifting



Whitney-Jensen Brake

making for speed and ease of operation For heavy work the bending apron i supported by an angle with welded gus sets for reinforcement. The die sho platen and front bending plate is mad of alloy steel, ground and highly finished



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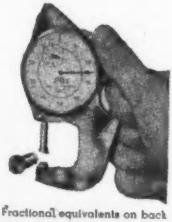


Fractional equivalents on back

B. C. AMES COMPANY
WALTHAM, MASS.

Tailored Taps

Taps to FIT YOUR PROBLEM

A Tapping Expert in a large manufacturing plant recently wrote this about a Special ⅝"—18 Bath Tap:

"This tap has outperformed any we have ever used and is so far in advance of all standard taps that I can hardly express my appreciation for the results obtained. "Up to this writing we have tapped about 4,000 nuts and every one is a perfect N.S.T.C. class 3 fit. We stepped up the speed of the machine to the maximum which is 1050 r.p.m. and still the tap refused to cut oversize. I have just examined the tap and it is impossible to see that it has been used."

Is this just "another testimonial?"—why not let us prove that "Tailored Taps" are better and can save you money.

Write us Today.

JOHN BATH & CO., Inc.
Taps—Chasers—Gages
WORCESTER, MASS.

All fitted parts are machined, making them interchangeable. The brake can be disassembled in three sections for ease in transportation.

Blanchard Style 4 Pulsolater

The March, 1934, issue of MODERN MACHINE SHOP contained an announcement of the Blanchard Pulsolator—an automatic oiling system for industrial equipment by which fresh oil is fed constantly to bearings while the journals are in motion. The Pulsolator is a product of Rivett Lathe & Grinder Corporation, Faneuil, Brighton, Mass.

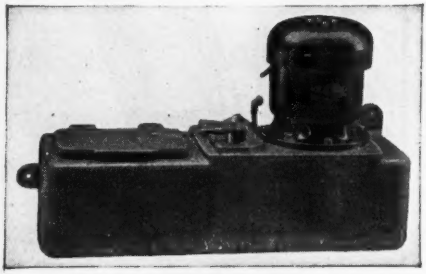


Fig. 1—Blanchard Style 4 Pulsolator

This company has now added to the line of Pulsators the No. 4 Pulsator, the feature of which is the modern type of drive. The Pulsator pumps oil through a main loop line which extends from the pumping unit with feeders arranged along the line singly or in gangs of two or more. The feeders are connected with their respective bearings by copper drip line. Oil is fed only during regular pulsations of the pumping unit and is always visible at these times through feeder sight glasses. Each feeder can be individually adjusted to suit the oil requirements of the bearings.

An indicating lever in full view on the oil reservoir bobs with each pulsation, recording the perfect operation of the system. All feeders can be made to flush their bearings by depressing this lever which is of especial value when starting a cold machine.

The Style 4 pumping unit has been developed for machine tool use and for plant installations where a large supply of oil with completely enclosed mechanism and individual motor drive is desired. The Style 4 Pulsolator is shown in Fig. 1 as it is shipped from the factory and in Fig. 2 lubricating an R. K. LeBlond Double Center Drive Crankshaft Lathe. The out-going and in-coming connections of the loop-line to the pump can be seen, and a rear view of the 37 gang feeders is visible at the top of the machine directly in front of the operators' position.

The pumping unit consists of a 4-gallon reservoir housing a Blanchard double plunger pump, a vertical flange-mounted ball bearing motor geared direct to the pump shaft, a large filler port with non-detachable cover and screen, and the indicating and flushing lever above mentioned. The reservoir is of cast iron with mounting lugs, two drain plugs for periodical cleaning out, a visible oil gauge glass, and a large filler port with deep undetachable filler screen.

The motor is flange-mounted on a removable reservoir cover. The motor shaft is geared direct to the pump shaft, and the gears run in a bath of oil at all times regardless of the oil level in the reservoir. A pulsation range from once

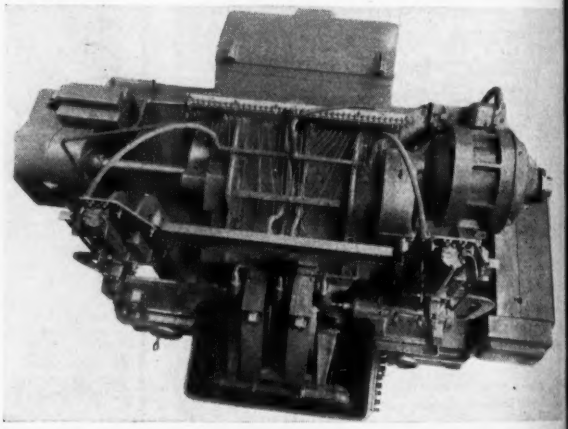


Fig. 2—Style 4 Pulsator applied to a LeBlond Crankshaft Lathe. This gang of 37 sight feeders is plainly visible to the operator.

every 7½ seconds to once every six minutes is available through the nine models of Pulsolators offered.

Brown Automatic Blanking Shear

R. H. Brown & Company, New Haven, Conn., have developed a line of automatic metal blanking shears to take sheets from 0.010 to 0.162 in. thick, from 4 in. to 36 in. wide, and up to 25 feet long. The blanks cut by the shears range from ⅛ in. to 36 in. wide. The machine illustrated takes sheets from 8 in. to 13 in. wide and up to 24 in. long. This machine holds as many as 225 sheets of 0.025 in. stock at one time.

The only hand operation required in operating the machine is loading the magazine with sheets, all other operations being done automatically even to ejecting the last piece. For narrow blanks there is an attachment which stacks the blanks as they are cut on the machine.

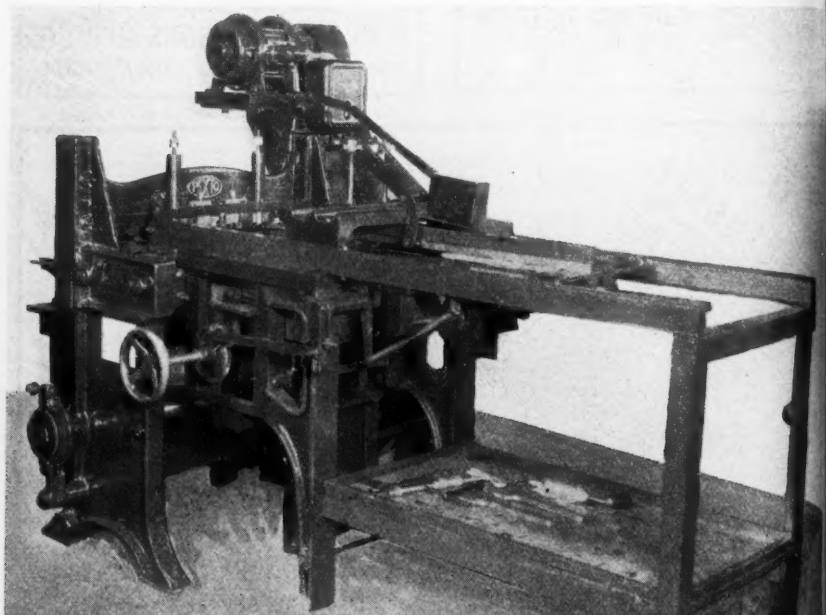
The carriage is made from a steel casting and rolls on precision ball bearings. Wearing parts are made from tool steel, hardened and ground to insure long life. The shears are built extra heavy to insure strength.

The machine is driven by a 1 h.p. ball bearing gear-head motor, through V-belt drive. The table is equipped with a thrust bearing and the bed is reinforced to prevent possibility of warpage. The speed of the machine is 110 blanks per minute.

Vulcan Boll-Weevil Tongs

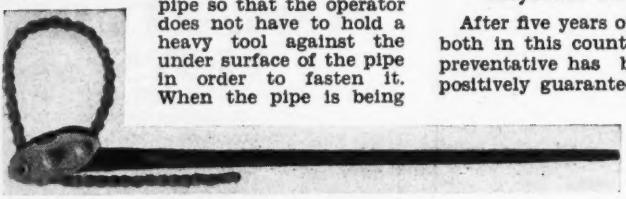
A reversible-action pipe tong, suitable for general work on pipe ranging from ¾ in. up to 12 in. diameter and known as the "Vulcan Boll-Weevil Tong", has been placed on the market by J. H. Williams & Company, 77 Spring St., New York, N. Y. The tong is particularly adapted for use on flat pipe work because of its extremely simple operation.

To use, the tong is laid on top of the



Brown Automatic Blanking Shear

pipe and the chain is hooked around the pipe so that the operator does not have to hold a heavy tool against the under surface of the pipe in order to fasten it. When the pipe is being tightened or "made up", the rear teeth of the tong are engaged and the operator pushes down on the handle. To loosen or "break out" the pipe, the tongs are merely pulled back so that the forward teeth engage the pipe and the operator lifts up on the handle. The jaws themselves are reversible so that when the teeth first in use have become worn, they can be reversed and the teeth on the opposite side of the jaw used.



"Vulcan Boll-Weevil" Pipe Tongs

There are but six parts to the "Boll-Weevil" tong. Two bolts secure the jaws, making it impossible for them to spread. The I-beam construction of the handle makes it extremely rigid.

Keystone Rust Preventative

After five years of research and testi both in this country and abroad, a r preventative has been developed that positively guaranteed to prevent rust all kinds of me parts. This pr duct — Keysto Rust Preventati — is being ma keted by the Ke stone Lubricati Co., 21st and Cle field Sts., Philadelphia, Pa.

Keystone Rust Preventative is said the manufacturers to be not only of ceptional worth where danger of corros is great, such as in export, but is said have all the qualities of a good lubrica and thus may be left upon moving pa when assembling.

In its natural state, Keystone Ru Preventative is a thin, brown fluid, but desired it can be dyed blue or red. The colors enable users to make certain th surfaces are completely coated. For sm articles, the preferred method of appli tion comprises submersion in a bath a then removal for drying. Larger artic are coated by means of a brush, clot or paint spray, and steel sheets a coated by the use of felt rollers.

Three to four hours of time are r quired for Keystone Rust Preventative set, in which time it develops into lasting film. This film is not affected b heat, moisture, or chemical fumes a under normal circumstances will adhe indefinitely. It is, however, easily r moved by wiping with a cloth that h been soaked in kerosene.

Keystone Rust Preventative is manu factured in three grades of density; ligh

medium, and heavy. The medium grade is recommended for use on machine tools, bolts and nuts, drills, reamers, and similar tools, automobile parts and engine parts. The light grade is used mostly for small springs, razor blades, and machinery of a very light nature. The heavy grade is intended for use on textile machines for jute or cotton, for heavy gears, and similar parts.

Grobet Machine Files

German filing machines are to be found in many of the diemaking shops in this country. The files that are used in these machines must be of the very highest grade of wormanship and quality if good results are to be obtained.

The Grobet File Corporation of America, 3 Park Pl., New York, importers of the Grobet Swiss Files, has added to its line of files for precision work a complete assortment of files for these German filing machines. A pamphlet illustrating 12 different shapes and sizes of these files made in two grades of cut—bastard and smooth—can be obtained by addressing the Grobet File Corporation as above.

Lincoln Automatic Welder For Mufflers

The illustration shows a machine for welding automobile muffler assemblies by the shielded carbon arc process which has been brought out by The Lincoln Electric Company, Dept. M-3, Cleveland, Ohio. The machine, equipped with an Electronic Tornado welding head, is said to have a production capacity of 115 mufflers per hour.

The equipment used consists of two machines, one a vertical machine as shown in the accompanying photograph, and the other a horizontal machine. With the welder illustrated the operator places the muffler in position, lowers the welding head, edge welds the tubes in place, raises the head, turns the muffler upside down and welds the pipe on the other end. The complete operation requires 30.5 seconds. Approximately 118 mufflers per hour may be welded with this machine. Actual welding is at the rate of 63 feet per minute.

A second machine lap welds muffler tubes for connection to the exhaust pipe. Floor to floor time is 112 mufflers per hour. In one installation in a large plant two men operate four of these automatic welders. The welding head remains stationary while the parts being welded revolve under the arc.

Lincoln automatic

This New Societe Genevoise Desk Type

Projector

provides an easy and rapid and very exact means of inspecting the form and accuracy of small parts of all kinds, including measurements on the surface of materials by Episcopic Illumination. Magnifications of 10X, 20X, 50X and 100X guaranteed exact to 1/2000th. No shadow of operator's head, hands or implements. Measurement made directly on the image. Drawings and photos easily made.

Ask for Catalog 577.

THE R. Y. FERNER CO.
926 Investment Bldg., Washington, D. C.

Anderson Improved

Balancing Ways

No Leveling Required

A simple and excellent device for balancing, straightening and trueing.

They are made in the following sizes:

Swing	Greatest Distance Between Standards	Capacity in Lbs.
20 in.	20 in.	1,000
40 in.	30 in.	2,000
60 in.	30 in.	2,000
72 in.	66 in.	5,000
96 in.	88 in.	10,000

Write For Full Information

Mfd. By **Anderson Bros. Mfg. Co.**
1926 Kishwaukee St., Rockford, Ill.

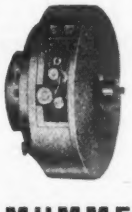
"PRECISION" INSPECTION

GAUGES

PLUGS RINGS
PROFILES SNAPS
ALL SPECIAL TYPES
CENTER FINDERS AND COMPARATORS

Send Blueprints for Quotation.

PRECISION GAGE & TOOL CO.
322 E. Third St., Dayton, O.



Mummert-Dixon Facing Heads

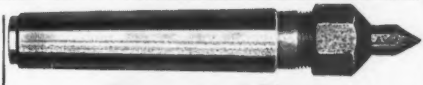
8 Sizes—6" to 40"

We can't say much here . . . but if you write for a bulletin we'll show you how this tool will save you money.

MUMMERT-DIXON CO.
120 Philadelphia St. Hanover, Pa.

Universal Nitrided Drill Bushings Wear Longer

Tool life is also increased. You get Precision and Accuracy at Low Cost. Made in the A. S. A. Standard. Interchangeable with other Standard Bushings. Optional Locks and Liners.



Universal Tool Holder Shanks

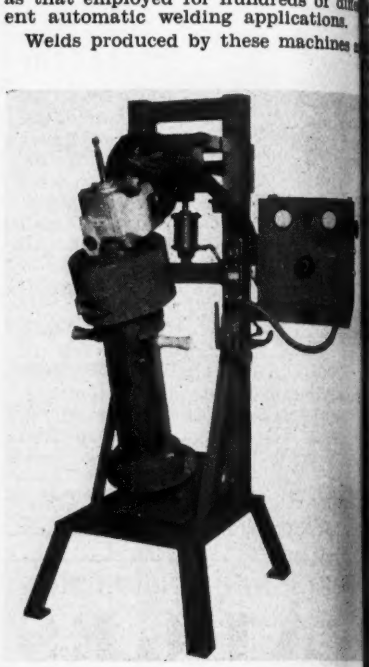
For End Mills, Drills and Center Points. Nitrided Center Points give long life without vibration.

Write for Data Sheets.

UNIVERSAL ENGINEERING CO., Frankenmuth, Michigan

muffler welders can be obtained f welding various types of mufflers. T welding head used is of the same ty as that employed for hundreds of diff ent automatic welding applications.

Welds produced by these machines a



Lincoln Automatic Welder for welding muffl assemblies by the shielded carbon arc proce

made by a shielded arc, insuring we strength greater than that of the ba metal and equal to it in ductility. T welds also show greater resistance t corrosion.

"Zaxol" High Power Disinfectan

Zaxol is a high power disinfectant th is being marketed by James Good, In 2111 East Susquehanna Ave., Philadelphi Pa., for use in cutting oils to prevent ski infections known as "Dermatitis." It stated by the manufacturer that, a though bacteriological tests of cutti oils before use fail to show the presen of bacteria, the same oils have sho numerous bacteria after having been us for some time. Such contaminated o enter the skin through abrasions or cu

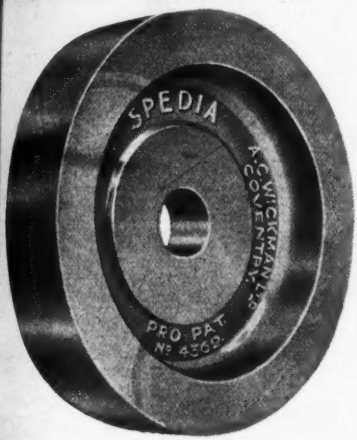
and cause boils or other forms of skin infections.

By adding Zaxol to the cutting oil before use, in the proportion of 1 to 400 parts, all pus-producing bacteria are killed. Although harmless to the skin, Zaxol is said to be 15 to 17 times stronger than pure carbolic acid crystals, five times more powerful than Cresol Compound U.S.P., and 50 to 60 times stronger than Formaldehyde when used as a liquid.

Zaxol mixes readily with cutting oils or with hard or soft water. It does not corrode metal.

"Spedia" Lapping Wheel

The fine finish which is considered so necessary to the proper operation of cemented carbide or other hard metal-



"Spedia" Lapping Wheel

cutting tools can quickly and easily be obtained by the use of the "Spedia" Lapping Wheel shown in the illustration. The Spedia Lapping Wheel is said by the manufacturers—Thomas Prosser & Son, 15 Gold St., New York, N. Y.—to produce a finish on the cutting edge that will compare with the edge heretofore obtained by the use of special cast iron laps charged with diamond dust. However, the tendency toward chipping is eliminated.

The wheel is stocked in cup form in the standard size of 3 in. diameter, ⅞ in. deep, ⅜ in. rib, ½ in. hole. The wheel is usually operated at a speed of 5,000 surface feet per minute, although a

slower speed can be used satisfactorily. A light pressure is used, and light oil of a good quality is applied to the face of the wheel. The lapping is done on the face of the wheel. The longer life of a tool that is lapped on a Spedia wheel, the higher production possible, and the better quality of finish on the work are said to return the cost of wheel within a reasonable length of time.

Card "Tap Selector"

Expert consulting service on taps and tapping jobs is now available to any manufacturer without charge—even for postage. All that the manufacturer or mechanical executive has to do is to fill out a "Tap Selector" data sheet and drop it into the mail. The "Tap Selector" is of the same size as a post card, with the information required indicated on one side and the name of the S. W. Card Mfg. Co., Mansfield, Mass., on the other. No postage stamp is necessary; postage will be paid by the S. W. Card Mfg. C

A supply of these "Tap Selectors" w be sent to any mechanical executive upo request. Upon receipt of a "Tap Selector filled in as indicated, the tap engineer of the Card Company will immediate give the sender instructions as to t

The CARD "TAP SELECTOR" Saves Money on Tap

FILL OUT FOR RECOMMENDATION OF CORRECT TAP FOR THIS JOB

Style Tap_____

Size_____ Pitch_____ Form_____

Kind of Material_____ Lubrication_____

Blind or Thru Hole_____ Drill Size_____

Depth of Engagement_____ Speed of Operation_____

Horizontal or Vertical Tapping_____

Name_____ Title_____

Company_____

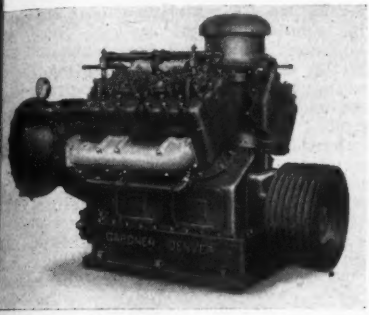
Address_____

Date_____ Send Sample of Work if Possible

proper style of tap to use to obtain the best results on the job.

Gardner-Denver Line of Vertical Air Compressors

Designed to deliver air at the lowest possible cost, a new line of vertical air compressors has been announced by the Gardner-Denver Company, Quincy, Ill.



Gardner-Denver Vertical Air Compressor

The new compressors are built to deliver the same amount of air as horizontal compressors of the same capacity although the installation, operating, and maintenance costs are said to be from 25 to 50 per cent less. In addition, the vertical compressor makes possible a saving in floor space.

Inlet and discharge valves are cushioned, and are silent, durable, and efficient. Extra large water jackets completely surround the cylinders and valves, assuring minimum cylinder temperatures. A water cooled inter-cooler saves power and increases volumetric efficiency by cooling air between stages.

The crankshafts are of forged steel and the bearings are of generous size. The shaft runs in three main bearings of the bronze-backed, babbitt-lined full circle type. Pressure feed lubrication is provided to all bearings through drilled passages, thus eliminating oil pipes—which are subject to breakage and leakage. A rotary pump assures constant and uniform oil pressure. Materials and workmanship are of the highest quality throughout.

J. & L. Tangent Dies and Ground Thread Chasers. An 8-page 8½x11 inch folder, describing the J. & L. Tangent dies and ground thread chasers made by Jones & Lamson Machine Co., Springfield, Vt., has been issued by that company. The uses and advantages of "tangent dies" are described in detail and the dies are fully illustrated, both in and out of the holder. Instructions for changing the chasers and for setting them accurately are included, with illustrations. Two pages are devoted to data sheets of dimensions of revolving and stationary dies and standard stock chasers. Instructions for grinding chasers by the J. & L. method are given, together with pictures of the J. & L. measuring gage and the J. & L. Tangent Chaser grinder. Copies gratis.

Sutton Tool Catalog No. 11

The complete line of Sutton standard collets, feed fingers, pads, spools, and nuts made by the Sutton Tool Company, 2842 West Grand Boulevard, Detroit, Michigan, is described and illustrated in Catalog No. 11, which has been issued by this company. The Sutton "Sur-Grip" Collet with Diamond Serrations and the Sutton Style "G" Compensating Collet are featured, the descriptions being amplified with photographs and sectional drawings.

Complete lists of specifications and prices of collets, feeders, feed fingers, and pads for all types of lathes, milling machines, hand screw machines, and automatic screw machines are included together with a page of directions for ordering.

A copy of the catalog can be had by any mechanical executive who will address his request on his firm letterhead.

Carboloy Announces Six New Grades

Carboloy Company, Inc., 2485 East Grand Blvd., Detroit, Michigan, announces the release of six new grades of Carboloy cemented carbide. These supplement the six existing grades and have been developed primarily to obtain improved performance in special fields of application, among which are the rough and finish boring, finish turning and facing of steel brake drums, single-point finish boring of steel connecting rods, re-boring automotive cylinders, and turning-facing-boring piston rings.

The release of these six new grades, designated as 715, 831, 833, 905, 906, and 907 is but the initial part of a long-range program which has for its ultimate objective the development of special grades for each field of application in which it is felt that improved results can be obtained.

The 12 grades of Carboloy cemented carbide now available will be found adequate, states the Carboloy Co., to give the user a high order of results on all present machining application within the existing range of cemented carbide use. The manufacturer will, however, continue to develop special grades for fields of application where it may be indicated that improved results can be obtained.

Sta-Put Lubricants

E. F. Houghton & Company, Philadelphia, Pa., has just announced an important development in its line of oils and greases bearing the trade name of "Sta-Put". These products were so named because the research laboratories of the above concern succeeded about two years ago in vastly improving mineral oils, a task on which chemists and engineers have been working for many

years. The initial step was to increase the ability of the oil to stay in place, by treating it with selected mineral hyro-carbons, thus creating straight mineral oils with "stay-put" qualities not heretofore obtained.

Now the Houghton research staff has perfected a further step in the process by chemically combining certain other hydro-carbons which greatly increase the load-carrying capacity of the oil. The lubricity, or combined properties of this product, not only increase the ability of the oil to stay in place as above outlined, but enormously increase the film strength, reducing wear and maint nance.

Shock loads or sudden reversals strain on bearing are adequately m with comparatively light weights of o without the addition of any materia which cause a change in the oil's ap pearance or ability to be used as oth mineral oils are used, and, furth without deterioration or thickening use or storage.

Further details on "Sta-Put" Lubri cants may be obtained by writing E. Houghton & Co., 240 W. Somerset S Philadelphia, Pa.